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MEDICARE PHYSICIAN EXPENDITURES:
SORTING OUT THE REASONS FOR GROWTH

John Holahan
Avi Dor
Stephen Zuckerman

**THE URBAN INSTITUTE**
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# I. INTRODUCTION

The recent increases in the Medicare Part B premium (38.5 percent between 1987 and 1988 and 12.5 percent between 1988 and 1989) have once again raised concerns over the growth in the volume of services provided to Medicare beneficiaries (3). While some of the increase reflected insufficient increases in premiums in previous years, most reflects an increase in underlying physician expenditures. Since physician fees have been either frozen or severely limited in recent years, mosts of the expenditure growth has been due to increases in service volume and intensity. For example, the Congressional Budget Office has recently estimated that physician services per enrollee increased by 6 percent and 9 percent respectively in 1984 and 1985 (3).

There continues to be little understanding of why Medicare volume has been increasing so rapidly. Many reasons are offered. One explanation is that the Medicare PPS system, introduced in October 1983, has resulted in a shift of care from inpatient settings to hospital outpatient or office settings, resulting in a shift from Part A (Hospital Insurance) to Part B (Supplementary Medical Insurance) of Medicare. The physician component of services previously provided to inpatients has always been billed under Part B. However, PPS could still affect the volume of physician services if a greater number of services are provided in order to facilitate earlier discharges or if a greater volume of physician services are provided when entire procedures are shifted out of the hospital.

There are two other ways in which the introduction of PPS could have resulted in the shift to Part B. First, billings by outpatient hospital departments, which are covered under Part B, could increase for the technical component of surgery, radiology, or other procedures. However, the outpatient component of Part B expenditures is less than 20 percent of all Part B;

therefore, even rapid growth in the outpatient setting could not explain a substantial share of Part B growth. These increases in outpatient department billings, while important, are not the focus of this study which concentrates only on physician services. Second, some physicians, e.g., radiologists and pathologists, whose services have previously been included as a hospital cost and reimbursed through the hospital (combined billing), are now required to bill separately. This change could result in an increase in Part B billings due to a shift from Part A. But, this change is due to the combined billing policy change and is not strictly a PPS effect.

Other explanations of recent growth include demand creation in response to the physician fee freeze, e.g., physicians increase volume to compensate for lower real fees, or a demand response by beneficiaries to lower out-of-pocket costs because of increased assignment rates following the Medicare physician participation agreement in 1984. This, coupled with the freeze in the SMI deductible, resulted in lower real out-of-pocket costs for beneficiaries perhaps resulting in a substantial increase in demand.

The third set of explanations involves a number of longer term factors. These include growth in real income for the elderly. The elderly have fared very well economically in recent years compared with other population groups in the U.S. This increased real income may have resulted in an increased demand for Medicare services. The increased aging of the population should also result in higher service volume. The growth in the supply of physicians could also result in an increased demand for service, either by increasing physician access (easier appointments, greater amenities, more time with patients, etc.) or by demand inducement, e.g., physicians face increased competition they tend to order more marginal tests, more follow-up visits, more surgery, etc. The rise in malpractice costs may result in physicians' practicing more

defensively, perhaps increasing the volume of certain services particularly diagnostic services.

The reductions in hospital lengths of stay that began prior to PPS may have resulted in fewer inpatient visits and other physician services. However, declines in hospital admissions and in lengths of stay may result in more outpatient and office services. The effect on overall volume is unclear, however, the volume of physician services may increase if the intensity of physician involvement increases in order to facilitate earlier discharge. The introduction of new medical technologies, finally, is likely to be an extremely important factor explaining the growth in service volume. Technological change in medical care has typically not been cost reducing, but rather has expanded the range of things that physicians can do to alleviate patient suffering, improve the quality of care, etc. Innovations can also result in the shift of care out of the hospital, e.g., cataract removal/lens implants in hospital outpatient departments.

This paper uses both descriptive and econometric analyses to shed light on the issue of increases in the volume of physician services. We describe the growth in Medicare expenditures between 1983 and 1985, using new data on changes in Medicare expenditures by type of service (medical care, surgery, consultations, radiology, and other) and by place of service (inpatient, outpatient, office, and other settings). We then examine how the growth in Medicare expenditures varies among different types of physician specialties (general practitioners, internists, cardiologists, general surgeons, ophthalmologists, orthopedic surgeons, radiologists, and others). While we offer some interpretations of the patterns we observe, we do not attempt in this section to formally test hypotheses.

In the following section we present an analytic model of the Medicare physician services market and provide a set of direct hypotheses. We then present the results of an econometric analysis. We have estimated a partial adjustment model to analyze the changes in the physician services market between 1983 and 1985. The model allows us to examine the role of a large number of factors, e.g., age and health status, physician supply and specialty composition, hospital admission rates and lengths of stay, etc. on the volume of physician services. We analyze five types of physician services (medical care, surgery, consultations, radiology, and a residual other category) and four sites of care (hospital inpatient, outpatient, physician offices and other). The final section provides our conclusions.

## II.  DATA

### Unit of Analysis

This study has used data from many different sources to construct comprehensive data files for 1983 and 1985. The principal variables of interest are measures of Medicare utilization and expenditures for each MSA in the United States; similar information has also been compiled for the non-MSA parts of each state (except for Rhode Island, and New Jersey). The primary advantage of the MSA/non-MSA classification as the unit of analysis is that many variables that could be used to explain cross-sectional variation and growth in utilization and expenditures are available. Another advantage is that the MSA is probably closer to an economic market than the alternatives (e.g., county, Medicare carrier area, state, census division, etc.) In choosing an appropriate area for analysis, a key issue that must be addressed is the extent of border-crossing, i.e., patients moving from one area to another in order to utilize health services. The census division would be an

area with relatively little border-crossing but one with a low degree of uniformity. Counties would be more homogeneous, but would exhibit unacceptable amounts of inter-county travel. Some middle ground is needed.

The MSA seems to fill this gap. It is large enough so as to enable most residents to get all of their care within the MSA and yet it is homogeneous enough to reflect, say, a single style of medical practice. While their could be some travel between MSAs for specialized care (a minor flaw that we are willing to live with), there is relatively little chance that MSA residents receive care in non-MSA areas. Therefore, by choosing the MSA based on the patient's residence as the geographic area of analysis (there are 318 MSAs in the country), we can approximate an economic market. We also include data on the non-MSAS parts of states in the analysis. All non-MSA parts of a state are considered one "market." We acknowledge that we are on much less solid ground here. However, the effects of recent policy changes on the volume of physician services in rural areas is too important to ignore. The observations on utilization are based on the beneficiary; thus the data captures all utilization including that when a rural beneficiary crosses borders to use services elsewhere, say in an MSA.

## Expenditure and Utilization Data

The expenditure and utilization data are drawn from four Medicare data sets. The two most important of these are the 1983 Bill Summary Record (BSR) file and the 1985 BMAD beneficiary file. Each of these files contains detailed information on Medicare services and expenditures for a 5 percent sample of Medicare beneficiaries. The 1983 BSR provides information on numbers of services, allowed charges, and submitted charges and assignment rates for each type and place of service and for each specialty. The 1985 BMAD beneficiary file contains even more detail on specific procedures as well as information on

numbers of services, allowed charges, submitted charges and assignment rates for the same types and place of service and specialties. Because the procedure-specific detail available in the 1985 BMAD is not also available on the 1983 Bill Summary Record, we have aggregated the 1985 BMAD data files to be consistent with the BSR. We have then aggregated the Bill Summary Record and BMAD statistics first from the beneficiary to the county level and then to the MSA level. For rural areas, we have aggregated all non-MSA counties within the state. We thus have computed numbers of services and expenditures for each of the above mentioned types and place of service as well as each medical specialty that provided services to Medicare beneficiaries in the 5 percent sample.

The third Medicare data set consists of enrollee counts from the 1983 and 1985 HISKUE Medicare history files. From these, we develop enrollee counts for each county and then for MSAs and for non-MSA parts of each state. Because the BSR and BMAD files contain data on only non-HMO enrollees, we then subtract HMO enrollees taken from HCFA's Average Adjusted Per Capita Cost (AAPCC) files from the overall enrollee totals. Dividing the 1983 BSR data by the adjusted 1983 enrollee counts and the 1985 BMAD data by the adjusted 1985 enrollee counts yields each of the measures of utilization and expenditures on a per enrollee basis by each type and place of service and medical specialty for both years. The ratio of HMO enrollees to total enrollees is also used as a separate variable in the analysis.

The fourth data set consists of indices of Medicare prevailing charges for medical care, surgery, and radiology developed from the 1983 and 1985 Medicare prevailing charge directories. These files contain prevailing charges for up

to 100 procedures in each Medicare pricing locality.[1] We have developed
indices for medical care, surgery, and radiology for each Medicare pricing
locality. The medical care index is used as our price index for consultations,
and weighted averages are used for other types, all services, and each place of
service. Then enrollee counts for each of the counties within each locality
and within each MSA and non-MSA part of each state were used to aggregate these
indices into a prevailing charge index for 1983 and 1985 for each MSA and non-
MSA part of each state.

With these four data sets we are able to compute Medicare allowed charges
per enrollee, two measures of volume, and a fixed weighted measure of price.
Dividing allowed charges per enrollee by the price index yields a measure of
volume/intensity, i.e., real expenditures per enrollee, that differs in
important ways from a simple count of services. That is, differences in
services per enrollee reflect simple differences in volume, independent of
differences in service mix, while real expenditures per enrollee captures both
differences in the volume of services and in the mix of services.

These data sets have some very important limitations, however. One is
that only data available by March 1986 is provided to Medicare by each carrier
in the 1985 BMAD file. The Bill Summary Record contains similar limitations.
If, for example, a carrier provided 85 percent of all claims in 1983, but 90
percent of all claims in 1985, the 1983/1985 comparison would overstate the
actual growth rate. Similarly, coding variations among carriers can result in
misclassification of services by type and place of service. The result is that
some geographic areas can erroneously report too few or too much service of

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1. Not all localities provide data on all procedures; thus developing a
   prevailing charge index for this data set involves making some imputations
   in order to develop the index. Our procedures for developing these indices
   are described more fully in Appendix A.

particular types and place of service combinations. We systematically examined distributions of data by type and place of service by MSA, as well as changes between 1983 and 1985 to identify geographic areas where data seem to be systematically over- or under-reported. The following areas have been excluded from the study:

o   All of Connecticut, Missouri, West Virginia and Ohio

o   Yakima, Washington

o   La Crosse, Sheboygan, and Madison, Wisconsin

o   Iowa City, Iowa

o   Rochester, Minnesota

o   Rural New Jersey and Rhode Island

## Other Data

Several other data sets augment these primary files. The HISKUE file also allowed us to identify the proportion of individuals in four age classifications: under 65, 65-74, 75-84, and over 85, as well as the proportion of Medicare beneficiaries in each county that was male or female, and white or nonwhite. Finally we determined the number who were eligible for Medicare through Old Age Assistance, disability, or renal disease.

The HISKUE file was also used to construct mortality rates which could be used as a health status indicator in the regression analysis. We have used the March 1983 and March 1985 versions of the HISKUE files to obtain 1983 and 1985 counts of individuals enrolled in Medicare during the preceding calendar year. This allows us to compute the number of individuals who were enrolled in the previous calendar year and who died. We can then compute mortality rates for 1982 and 1984 for the Medicare population.

Medicare data do not contain information on income and private supplementary insurance coverage for the elderly. The Current Population

Survey does have information on these variables. The 1984 and 1986 CPSs provide data on 1983 and 1985 income per capita, as well as the presence of insurance coverage in addition to Medicare: Medicaid, Group Health, other private health insurance, or CHAMPUS. We have used data from the CPS to impute average income and the average proportion of the population with supplementary insurance for each MSA.

Data on hospital characteristics from the 1983 and 1985 versions of the American Hospital Association's Annual Survey were used to obtain measures of the number of hospitals and the number of beds in each MSA. The surveys provide data on the proportion of beds by teaching status (Council of Teaching Hospitals [COTH], minor teaching or nonteaching hospitals) and by ownership (proprietary, nonprofit, or government owned); the number of medical staff per bed; the number of full-time personnel per bed; the number of surgical operations—both ambulatory and in total—in each hospital; Medicare and non-Medicare lengths of stay; and Medicare and non-Medicare admissions. All of these variables were constructed for each MSA and non-MSA area.

Data on the availability of physicians comes from the American Medical Association Annual Surveys. We use information on all practicing nonfederal physicians, as well as the data that is available on general practitioners, medical specialists, surgical specialists, and other specialists. The AMA surveys also provide information on hospital-based physicians, consisting largely of interns and residents, which we use as a measure of teaching capacity. Each of these variables are available at the county level. We have aggregated, as with other data sets, to the MSA level and to non-MSA parts of each state. We also added information on nursing home bed capacity and the proportion of nursing home beds that are certified to provide skilled nursing care.

A number of other variables were used in the analysis. These included a
measure of the political conservatism of the geographic area—the proportion of
the state population voting for Ronald Reagan in 1980. Another variable used
in the analysis is the geographic medical economic index (GMEI) constructed by
Zuckerman and Welch. This is a weighted price index based on all the major
inputs into medical practice (9). We have also used individual components of
the index, including a measure of fair market rents produced by the U.S.
Department of Housing and Urban Development (HUD) for all areas with a Section
8 Housing Assistance Program. These data are published annually in the Federal
Register and represent the 45th percentile for various sized units in each
geographic market. Data on malpractice premiums are also included as a measure
of area malpractice risk. HCFA has conducted a survey of malpractice carriers
since 1975. This survey is used to estimate the change in the average annual
premium of a policy providing $100,000/$300,000 of professional liability
coverage. This variable was available by state for each of several
specialties. Zuckerman and Welch combined malpractice insurance data to obtain
average measures at the state level. The final area characteristics used are
the proportion of each area's population in poverty based on data from the 1980
Census and state unemployment rates from data published by the Bureau of Labor
Statistics.

### III. THE GROWTH IN PHYSICIAN SERVICES, 1983-1985: A DESCRIPTIVE ANALYSIS

In this section we examine changes in physician services by type and place
of service, and by specialty. Because of interest in the issue of whether PPS
has resulted in an increase in physician services, we focus attention on

comparisons between PPS and waiver states before (1983) and after (1985) the introduction of PPS. These comparisons should shed some light on the impact of PPS, because most of the other factors which may affect volume are likely to have changed in similar ways in all states. This permits us to isolate the effect of PPS—the new hospital payment system occurred only in the PPS states, not in the waiver states. The econometric analysis described in Sections IV and V enhances this investigation by controlling explicitly for a large number of other factors.

Because the objective of this paper is to better understand the recent growth in Medicare expenditures, we look at the underlying changes in the volume and mix of services. For each type and place of service and specialty, we will describe the growth in expenditures per enrollee, two measures of service volume, and two measures of price increases. The data we use here are actually Medicare allowed charges rather than expenditures; the difference is that beneficiary deductible and coinsurance obligations are included in allowed charges but not in Medicare expenditures. Allowed charges also differ from physician revenues for services to Medicare beneficiaries because of balance billing. Because of the close relationship between expenditures and allowed charges, we treat the latter as Medicare expenditures. The first volume measure is a simple count of services per enrollee for each type and place of service and specialty. In addition, we deflate expenditures by an index of Medicare prevailing charges to examine the real growth in Medicare expenditures. Increases in services per enrollee reflect simple changes in volume, independent of changes in service mix, while real expenditures capture both changes in services and changes in the mix of procedures.

Finally, we look at changes in allowed charges per service and at an index of prevailing charges. The former includes pure price differences as well as

changes in average charges due to a shift in mix of services. The latter
provides a measure of the change in prices for a constant mix of services.
Differences between the two price measures indicate a change in service
complexity, e.g., an increase in allowed charges per service that is faster
than the increase in the prevailing charge index, for example, indicates an
increase in service complexity.[2]

## Results

The results are presented in the following four tables. These tables show
the percentage changes in expenditures and in each of the two volume and price
measures described above between 1983 and 1985. In Table 1, changes in
expenditures, places, and services are shown for each region and separately for
all PPS and waiver states. The data show that Medicare expenditures per
enrollee grew by almost 15 percent between 1983 and 1985. There was one
increase in Medicare prevailing charges during this period, in July 1983, after
which they were frozen until May 1986. As a result, Medicare prevailing
charges increased nationally by only 3.6 percent, resulting in a growth in real
expenditures of 10.8 percent over the two-year period. This is less than the 6
to 9 percent volume growth per year cited earlier. This is primarily because
the 1985 BMAD data is less complete than the 1983 BSR; the former includes all

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2. Computationally, these can be written as:

$$AC/ENR = AC/S \times S/ENR$$

$$\text{and} \quad AC/ENR = \frac{AC/ENR}{PCI} \times PCI$$

where AC = allowed charges
      ENR = Medicare enrollees
        S = services
      PCI = prevailing charge index

Table 1

Percent Change in Medicare Expenditures
All U.S., 1983-1985

| | Medicare Expenditures per Enrollee | Allowed Charges per Service | Services Per Enrollee | Prevailing Charge Index | Real Expenditures per Enrollee |
|---|---|---|---|---|---|
| Region | | | | | |
| New England | 19.13% | 5.99% | 12.40% | 2.92 | 15.75 |
| Middle Atlantic | 18.81 | 2.97 | 15.38 | 2.81 | 15.56 |
| South Atlantic | 14.03 | 8.24 | 5.35 | 3.39 | 10.29 |
| E. N. Central | 11.47 | 10.56 | 0.83 | 3.59 | ·7.61 |
| W. N. Central | 15.90 | 3.75 | 11.70 | 4.42 | 10.99 |
| E. S. Central | 15.00 | 14.30 | 0.61 | 3.09 | 11.55 |
| W. S. Central | 14.72 | 16.01 | −1.10 | 4.70 | 9.57 |
| Mountain | 20.95 | 7.57 | 12.44 | 3.14 | 17.27 |
| Pacific | 10.16 | 4.93 | 4.98 | 3.01 | 6.94 |
| All | 14.78 | 7.65 | 6.62 | 3.56 | 10.83 |
| | | | | | |
| PPS | 14.27 | 7.96 | 5.85 | 3.69 | 10.20 |
| WAIVER | 16.97 | 6.10 | 10.24 | 2.27 | 14.37 |

claims submitted within three months after the end of the year, while the latter includes claims submitted within nine months. The analysis also excludes all nonphysician services. On the other hand, customary charges probably grew faster than prevailing charges. By using the prevailing charge adjustment as a deflator, we may have understated the growth in fees and overstated the growth in real expenditures.

Most of the increase in real expenditures is due to an increase in volume (6.6 percent). The remainder can be attributed to a change in the mix of services. Allowed charges per service grew by 7.7 percent, about four percentage points faster than increase in the prevailing charge index, indicating a shift to a slightly more complex mix of services. This pattern of a slightly increased mix of services is borne out in all but one region. However, there seems to be considerable variance among the regions in the growth in the number of services.

In general, the New England, Middle Atlantic, and Mountain regions had the fastest growth rate in Medicare expenditures. The East North Central and Pacific regions had the slowest growth rates. The three former regions had the fastest growth in services per enrollee as well as the fastest growth in real expenditures. The Pacific region had relatively slow growth in services and real expenditures. Several other regions had very low growth in services which, in turn, translated into low growth in real expenditures.

PPS states had slightly slower growth than did the waiver states in Medicare expenditures per enrollee for all services included in this study. The PPS states had faster growth, however, in both the prevailing charge index and in allowed charges per service, implying that the slower growth in nominal expenditures in PPS states was due to even slower rates of growth in services per enrollee and in real expenditures. Thus, this limited evidence suggests

that PPS did not contribute to the growth in Part B expenditures and, if anything, may have reduced it.

The next three tables look at the same evidence in more detail. Table 2 disaggregates the data by type of service. It is clear that the fastest growing type of physician service is radiology. But, as indicated in the introduction, much of this may be due to the change in provisions regarding combined billing. That is, radiology charges were no longer included as part of hospital costs; rather radiologists were expected to bill separately. This in itself could lead to an increase in charges in Part B without an actual increase in number of services being provided. This is not a PPS effect because it applied to all states regardless of whether or not they were on the PPS system.

The growth rates for medical care, surgery, consultations, and other services were rather similar, ranging from 11.3 percent for medical care to 13.8 percent for consultations. The growth in medical care services was due both to growth in fees and to an increase in services per enrollee of about 3 percent. There also appears to have been some change in the mix of services, since allowed charges per service increased somewhat faster than the prevailing charge index. This trend was particularly evident in the waiver states, where allowed charges per service grew at a rate almost four times the rate of the prevailing charge index. The waiver states also had faster growth in the number of medical care services per enrollee than did the PPS states and thus had a faster rate of growth in real expenditures. During this period, PPS states had a much greater decline in the average length of stay in hospitals. It may be that there was a reduction in hospital visits that accompanied these declines in lengths of stay without an offsetting increase in office and

Table 2

Percent Change in Medicare Expenditures, 1983–1985, by Type of Service

| | Percentage of 1985 Expenditures in U.S. | Medicare Expenditures per Enrollee | Allowed Charges per Service | Services Per Enrollee | Prevailing Charge Index | Real Expenditures |
|---|---|---|---|---|---|---|
| **Medical Care** | | | | | | |
| All States | 35.2% | 11.30% | 8.09% | 2.96% | 4.01 | 7.00 |
| PPS | | 10.51 | 8.07 | 2.26 | 4.33 | 5.92 |
| WAIVER | | 14.64 | 7.86 | 6.29 | 1.52 | 12.92 |
| **Surgery** | | | | | | |
| All States | 32.2 | 13.79 | −2.49 | 16.69 | 2.96 | 10.51 |
| PPS | | 13.60 | −3.56 | 17.79 | 2.97 | 10.32 |
| WAIVER | | 14.65 | 3.10 | 11.20 | 2.78 | 11.55 |
| **Radiology** | | | | | | |
| All States | 11.2 | 31.77 | 9.49 | 20.35 | 3.56 | 27.24 |
| PPS | | 31.44 | 10.75 | 18.68 | 3.61 | 26.86 |
| WAIVER | | 33.30 | 3.76 | 28.46 | 2.61 | 29.91 |
| **Consultation** | | | | | | |
| All States | 3.4 | 13.78 | −0.11 | 13.90 | 3.88 | 9.53 |
| PPS | | 12.14 | 0.02 | 12.11 | 4.15 | 7.67 |
| WAIVER | | 19.62 | −0.87 | 20.67 | 2.14 | 17.11 |
| **Other Types of Service[a]** | | | | | | |
| All States | 18.0 | 12.90 | * | * | * | * |
| PPS | | 12.47 | * | * | * | * |
| WAIVER | | 14.91 | * | * | * | * |
| **All Types** | | | | | | |
| All | 100.0 | 14.78 | 7.65 | 6.62 | 3.56 | 10.83 |
| PPS | | 14.27 | 7.96 | 5.85 | 3.69 | 10.20 |
| WAIVER | | 16.97 | 6.10 | 10.24 | 2.27 | 14.37 |

a. The growth rates for "Other Types of Service" include diagnostic laborabory, anesthesia, assistants at surgery, and other medical services provided by physicians. Because it is such a heterogeneous group of services, we do not report changes in services or attempt to estimate real expenditure growth.

outpatient visits. The result is a slower rate of growth in medical care services in the PPS states than in the waiver states.

Surgery expenditures increased at roughly comparable rates in PPS and waiver states. However, PPS states had a much faster growth in the number of surgical services (11.8% vs. 11.2%). At the same time, there appears to have been a decline in the average complexity of surgical procedures performed in PPS states but a slight increase in waiver states. Changes in volume and service complexity roughly offset each other and, as a result, real and nominal expenditures grew at comparable rates in PPS and waivers states.

Radiology expenditures grew faster than any other service, as noted above. If this was a PPS phenomenon, however, the rate of growth would have been faster in the PPS states than in the waiver states. In fact, growth rates were slightly greater in the latter. Thus, most of the rapid growth in radiology outlays should probably be attributed changes in to combined billing. It is noteworthy that services grew faster in the waiver states than in the PPS states, but the average complexity of radiology procedures grew more rapidly in the PPS states. This may be an indication of a possible PPS effect, e.g., a different mix of services was moved out of the hospital in PPS states, resulting in a more complex mix of services being performed. One possible explanation may be that, in the waiver states, radiology services continue to be done in the hospital but the professional component was billed separately under Part B. As a result, the average charge per service grew at approximately the same rate as the prevailing charge index, a measure of the change in prices for a constant bundle of services. In the PPS states, in contrast, entire procedures may have been moved outside of the hospital because of the PPS incentives. The result would have been a higher proportion of billings for entire procedures, as opposed to professional (physician)

components, and, as a result, allowed charges for services grew faster than the prevailing charge index. This, of course, does not explain the faster overall growth in the <u>number</u> of radiology procedures in the waiver states.

Consultations grew substantially faster in the waiver states than in PPS in terms of both services per enrollee and real expenditures. This may possibly be related to the effect of the decline in hospital utilization under PPS. However, the allowed charges per service grew at a slower rate than the prevailing charge index in both PPS and waiver state, indicating that the average complexity of consultations declined everywhere. That is, it appears that consultations became more frequent, but that the growth was for relatively brief and limited consultation services.

Other types of services include diagnostic laboratory, anesthesia, assistants at surgery, and other medical services. Since this represents such a heterogeneous group of services, it is difficult to interpret service counts or develop a prevailing charge index. The figures on nominal expenditures, however, indicate somewhat faster growth in waiver states. Thus, it does not seem that the growth in these services can be attributed to PPS. Some of the increase may be due to the end of combined billing for hospital laboratory services, as with radiology. But since this occurred in all states, it was not a PPS phenomenon.

Changes in Medicare expenditures in each price and service measure by place of service are shown in Table 3. Expenditures for physician services provided in hospital inpatient settings declined by about 3.4 percent nationally. This reflects a decline in services of about 6.3 percent and a decline in real expenditures of 6.7 percent. Differences between PPS and waiver states are quite apparent. Expenditures in the waiver states grew by 4.8 percent, reflecting an increase in services of 6.2 percent. After

Table 3

Percent Change in Medicare Expenditures, 1983-1985, by Place of Service

| | Percentage of 1985 Expenditures in U.S. | Medicare Expenditures per Enrollee | Allowed Charges per Service | Services Per Enrollee | Prevailing Charge Index | Real Expenditures |
|---|---|---|---|---|---|---|
| **Hospital Inpatient Care** | | | | | | |
| All States | 50.8% | -3.37% | 3.14% | -6.31% | 3.61 | -6.74 |
| PPS | | -5.21 | 4.07 | -8.92 | 3.68 | -8.57 |
| WAIVER | | 4.82 | -1.28 | 6.18 | 2.57 | 2.19 |
| **Hospital Outpatient Care** | | | | | | |
| All States | 11.4 | 117.53 | 45.03 | 49.99 | 2.98 | 111.24 |
| PPS | | 123.33 | 48.45 | 50.43 | 3.12 | 116.57 |
| WAIVER | | 89.85 | 28.34 | 47.93 | 2.19 | 85.78 |
| **Office** | | | | | | |
| All States | 30.5 | 29.14 | 11.93 | 15.37 | 3.66 | 24.58 |
| PPS | | 29.73 | 11.50 | 16.35 | 3.75 | 25.04 |
| WAIVER | | 26.95 | 14.71 | 10.67 | 1.81 | 24.69 |
| **Other Sites of Care**[a] | | | | | | |
| All States | 7.2 | 57.67 | * | * | * | * |
| PPS | | 68.79 | * | * | * | * |
| WAIVER | | 25.83 | * | * | * | * |
| **All Places** | | | | | | |
| All | 100.0 | 14.78 | 7.65 | 6.62 | 3.56 | 10.83 |
| PPS | | 14.27 | 7.96 | 5.85 | 3.69 | 10.20 |
| WAIVER | | 16.97 | 6.10 | 10.24 | 2.27 | 14.37 |

a. The other sites of care category includes independent laboratories, nursing homes, ambulatory surgery centers, homes and other settings. The growth rates for each setting include all types of services used in the previous table. Again, because this category includes many different kinds of services, we do not attempt to disaggregate to growth in nominal expenditures.

deflating by the change in the prevailing charge index, real expenditures increased by 2.2 percent. In PPS states, in contrast, Medicare expenditures for inpatient services declined by 5.2 percent, reflecting a reduction in services of 8.9 percent. Since the prevailing charge index increased by 3.7 percent in PPS states during these two years, real expenditures declined by 8.6 percent. Thus, the difference between PPS and waiver states is quite stark.

Unlike inpatient care, hospital outpatient care grew much faster in PPS states than in waiver states. Of course, it is important to remember that average expenditures nationally for hospital outpatient care were about $65 per enrollee, while expenditures on hospital inpatient care were approximately $290. Thus, the growth in hospital outpatient care is from a much lower base. Increases in hospital outpatient care were due to both very rapid growth in services per enrollee (approximately 50 percent over the two year period) and a substantial increase in allowed charges per service (45 percent). Thus, there was both a massive increase in the number of services and a very large increase in service complexity as more complicated and more expensive services were shifted to the hospital outpatient department. It is clear that there was a fairly substantial increase in services per enrollee provided in both PPS and waiver states. However, there is much more of an increase in service complexity in PPS states than in waiver states. The result is substantially faster growth in real expenditures in PPS states than in waiver states.

Services provided in physicians' offices are a much greater share of physician expenditures than those provided in hospital outpatient settings. The overall growth in expenditures on office services was slightly more than 29 percent over the two-year period, reflecting an increase in service volume of 15.4 percent. Since the prevailing charge index increased by about 3.7 percent, this meant an increase in real expenditures of 24.6 percent over the

two-year period. Allowed charges per service increased by 11.9 percent—almost three times the rate of change in the prevailing charge index—suggesting an increase in the complexity of services provided in physicians' offices.

Unlike outpatient departments, the growth in Medicare expenditures was similar for both PPS and waiver states. PPS states experienced a growth in service volume of about 16.4 percent versus 10.7 percent in waiver states. On the other hand, the mix of services seems to have increased more rapidly in the waiver states. As a result, real expenditures increased by about the same in both PPS and waiver states making it somewhat difficult to draw conclusions.

Finally, all the remaining places of services (which include independent laboratories, ambulatory surgery centers, nursing homes, private homes) were aggregated into other sites of care. Because the category includes many different places of service, it is difficult to interpret service counts and to estimate changes in real expenditures. However, growth in nominal expenditures was almost 60 percent for the two-year period. Some of this may reflect the Deficit Reduction Act regulations requiring direct billing for laborary services that began in July 1984. But the much more rapid growth that took place in PPS states suggests an increased provision of services, perhaps laboratory tests, medical supplies, etc., in out-of-the-hospital settings.

Table 4 presents the same information on a specialty-specific basis. The most important results in this table are the differences in both expenditure and service growth rates across specialties. The data provided for all states make it clear that the growth in expenditures and service volume was particularly rapid for cardiology, ophthalmology, radiology, and other specialties. As indicated above, the increase in radiology expenditures could be due to changes in provisions for combined billing. However, the increases in services and expenditures for cardiologists, ophthalmologists and other

Table 4

Percent Change in Medicare Expenditures, 1983-1985, by Specialty

| | Medicare Expenditures per Enrollee | Allowed Charges per Service | Services Per Enrollee | Prevailing Charge Index | Real Expenditures |
|---|---|---|---|---|---|
| **General and Family Practice** | | | | | |
| All States | 5.86 | 10.78 | −4.44 | 4.76 | 1.05 |
| PPS | 6.24 | 11.17 | −4.43 | 4.90 | 1.28 |
| WAIVER | 2.14 | 7.59 | −5.07 | 3.03 | −0.86 |
| **General Surgery** | | | | | |
| All States | 6.79 | 16.80 | −8.57 | 3.13 | 3.55 |
| PPS | 5.99 | 16.35 | −8.91 | 3.10 | 2.80 |
| WAIVER | 9.92 | 18.28 | −7.07 | 3.16 | 6.55 |
| **Internal Medicine** | | | | | |
| All States | 9.67 | 8.75 | 0.85 | 3.67 | 5.79 |
| PPS | 10.25 | 9.07 | 1.08 | 3.92 | 6.09 |
| WAIVER | 7.97 | 7.73 | 0.22 | 2.03 | 5.82 |
| **Cardiology** | | | | | |
| All States | 43.21% | 0.54% | 42.45% | 3.97 | 37.74 |
| PPS | 40.18 | −0.71 | 41.19 | 3.97 | 34.83 |
| WAIVER | 54.75 | 5.32 | 46.94 | 3.64 | 49.31 |
| **Ophthalmology** | | | | | |
| All States | 14.47 | −5.71 | 21.41 | 2.95 | 11.19 |
| PPS | 13.36 | −7.51 | 22.56 | 3.03 | 10.03 |
| WAIVER | 18.81 | 1.01 | 17.62 | 2.05 | 16.42 |
| **Orthopedic Surgery** | | | | | |
| All States | 12.05 | 8.61 | 3.17 | 3.30 | 8.47 |
| PPS | 12.46 | 8.91 | 3.26 | 3.39 | 8.77 |
| WAIVER | 10.20 | 7.31 | 2.69 | 2.46 | 7.55 |
| **Radiology** | | | | | |
| All | 24.17 | 6.43 | 16.67 | 3.49 | 19.98 |
| PPS | 24.18 | 7.11 | 15.93 | 3.55 | 19.92 |
| WAIVER | 24.14 | 3.06 | 20.45 | 2.58 | 21.02 |
| **Other Specialties** | | | | | |
| All States | 17.62 | 3.22 | 13.95 | 3.74 | 13.38 |
| PPS | 16.61 | 4.19 | 11.92 | 3.91 | 12.22 |
| WAIVER | 22.02 | −1.26 | 23.58 | 1.71 | 19.97 |
| **All Specialties** | | | | | |
| All | 14.78 | 7.65 | 6.62 | 3.56 | 10.83 |
| PPS | 14.27 | 7.96 | 5.85 | 3.69 | 10.20 |
| WAIVER | 16.97 | 6.10 | 10.24 | 2.27 | 14.37 |

specialties (e.g., gastroenterologists, thoracic surgeons, urologists, etc.) may be due to technological innovations, permitting these specialists to provide newer and more innovative services for patients.  Orthopedic surgeons had expenditure growth of about 12 percent but did not have very rapid increases in services.  The remaining specialties--general practitioners, general surgeons, and internists--had relatively low rates of growth and expenditures, as well as declining or relatively constant numbers of services. These results lead one to the conclusion that much of the growth in expenditures may have been due to changes in technology, e.g., cardiac catheterzations, lens implants, fiber-optic procedures, etc.

In contrast to the differences across specialties, the differences between the PPS and waiver states yields no clear pattern.  Waiver states had a much faster growth in both expenditures and services for cardiologists, general surgeons, ophthalmologists, and other specialties.  But they had somewhat slower growth rates for general and family practitioners, internists, and orthopedic surgeons.

## Summary of Descriptive Evidence

These results are purely descriptive but indicate the following.  First, there appears to have been a somewhat faster increase in most services-- including medical care, radiology, consultations, and other--in waiver states than in PPS states.  A prominent exception is the faster rate of growth in surgical procedures in PPS states.  But since both nominal and real growth rates for surgery expenditures were comparable in PPS and waiver states, this growth seems to have taken place among less complex surgical procedures.

Second, both expenditures and services provided in inpatient settings showed positive growth in waiver states but declines in PPS states.  The differences in growth rates for inpatient settings are quite substantial.  Real

expenditures declined by almost 9 percent in PPS states while increasing by 2 percent in waiver states. Offsetting this to some extent is faster rate of growth in PPS states than in waiver states for both services and nominal expenditures for care provided in private offices, hospital outpatient departments and other settings. Only in the latter, however, are real expenditures substantially different between PPS and waiver states. A considerable shift in the complexity of services provided in all outpatient settings is evident in all states, but particularly in the PPS states. Our basic conclusion is that PPS resulted in a substantial shift in the site of care but not in an increase in overall physician expenditures.

Third, changes in combined billing regulations resulted in a very large increase in Part B radiology expenditures as well as payments to radiologists. This is the result of changes in provisions affecting hospital billing rather than an effect of PPS. Nonetheless, it contributed to the growth in Part B outlays without necessarily reflecting any change in service provision.

Finally, there are major differences among specialties in the growth of both services and nominal and real expenditures. Cardiologists had by far the fastest growth rates. Ophthalmologists, radiologists, other specialties, and orthopedic surgeons also had double-digit growth rates over the two-year period. In contrast, expenditures on services of general and family practitioners, general surgeons, and internists grew at much lower rates. Services per enrollee declined for both general practitioners and general surgeons and were roughly constant for internists. This suggests that growth in service volume during this period was driven by access to new technologies rather than by either increased demand by beneficiaries in response to lower out of pocket costs or increased income, or to successful efforts by physicians

to create demand. It is also consistent with the view that physicians' ability to create demand is affected by access to newer technologies.

## IV. ANALYTICAL FRAMEWORK FOR REGRESSION ANALYSIS

In this section we specify a model of the Medicare physician service market that will form the basis of our econometric investigation. The ultimate objective of the model is to understand the relationship between a number of market characteristics and policy variables on the use of physician services and, ultimately, their effect on Medicare expenditures. We focus the discussion on the effect of hospital cost containment policies on admissions and lengths of stay and, in turn, the effects of the latter on the use of services.

The PPS system introduced strong incentives to reduce lengths of stay, and to some extent, hospital admission rates. Thus, PPS may affect the use of physician services through shifts in inpatient volume. It is precisely this relationship that we wish to capture in the empirical model we present. However, we emphasize that other factors such as growth in the incomes of the elderly, in the supply of physicians, and in assignment rates are of equal interest. The core of this model is as follows:

(1) $Q_s = Q_s(P,S)$

(2) $Q_d = Q_d(P,ADM,LOS,D)$

(3) $Q^s = Q^d$

(4) $ADM = ADM(V,PPS)$

(5) $LOS = LOS(V,PPS)$

The terms $Q_d$ and $Q_s$, respectively, are the quantity demanded and quantity supplied of physician services in the area. P represents price per service, ADM the hospital admissions rate in the area, and LOS mean length of stay; D is a vector of demographic and market characteristics and health status indicators that affect only demand; S is a vector of factors that affect the cost of practice and hence, the supply of services; V is a vector of factors that affect inpatient admissions and lengths of stay, and PPS is the policy parameter.[3]

The equilibrium quantity of physician services is obtained from equating quantity demanded and quantity supplied. This yields the following equations

(6) $\quad Q^* = Q^*(D,S,V,PPS)$

(7) $\quad P^* = P^*(D,S,V,PPS)$

(8) $\quad ADM^* = ADM^*(D,S,V,PPS)$

(9) $\quad LOS^* = LOS^*(D,S,V,PPS)$

Equations 1-5 are called structural equations because they are functions of both exogenous and endogenous variables. Equations 6-9 are called reduced form equations because they are functions only of exogenous variables. Given the policy concerns outlined in the introduction, our interest is in measuring the effect of inpatient volume on utilization of physician services in the area. For this reason we estimate the structural demand equation. To avoid the bias arising from simultaneous equations, we will estimate this equation with two-stage least squares. Other variables that are endogenous to the Medicare

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3. These factors are discussed in detail in our full report. To simplify the discussion here, we assume that only equilibrium levels in the inpatient services market affect the market for physician services. Specifying separate demand and supply equations has no effect on the 2SLS model.

market, such as the assignment rate and the composition of physician supply (specialists and general practitioners), are incorporated into this framework without loss of generality.

In what follows we present the full specification of the structural demand equations. We begin with the demand equation[4]

(10) $Q_d$ = f(P*, ASS*, INS, Z, SPEC*, GP*, MAL, ADM*, LOS*, PPS, HMO, INC, HBPOP)

where $Q_d$ = quantity demanded
P* = the prevailing charge index for the area
ASS* = the area assignment rate
INS = proportion of area elderly population with additional insurance coverage
Z = a vector of demographic characteristics that may influence demand
SPEC* = the ratio of specialists to population
GP* = the ratio of general practitioners to population
MAL = area malpractice premiums, an average for each state
ADM* = area hospital admission rates
LOS* = area average length of stay
PPS = states which have waivers from the PPS system
HMO = HMO enrollees per Medicare beneficiaries
INC = income per capita for the elderly
HBPOP = the ratio of hospital based physicians to total population

First, the quantity demanded is posited to be a function of the out-of-pocket price facing the consumer. The price variable in this market is unusually complicated. The base price is represented by the prevailing charge index for the area, an index of prices facing both physicians and beneficiaries

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4. Variables with asterisks are endogenous and are estimated using two stage least squares procedures.

in the area.[5]  However, it is only an index of the price facing the beneficiary

(1) when the physician accepts assignment, i.e., does not balance bill, and

(2) when the patient does not have supplementary insurance coverage.  To

control for these two latter factors, we also control for assignment rates--the

proportion of charges in the area where the physician accepts assignment.  We

also control for the proportion of patients with supplementary insurance, a

measure of the proportion of area beneficiaries who face either zero out-of-

pocket costs or costs well below prevailing charges.  Both are expected to be

positively related to our measures of utilization.

Our expectations for the sign of the prevailing charge index, however, are

much less clear.  There are at least three possible models of the Medicare

physicians service market; each yields different hypotheses about the effect of

prevailing charges on utilization.  In the first model, displayed in Figure 1,

we begin with the standard formulation of physicians operating in a market in

which they are both price setters and price takers (4,6,7).  They are price

setters along the downward sloping part of the demand curve.  This is the part

of the Medicare demand curve in which patients are billed above allowed charges

on a nonassigned basis.  The price taking part of the demand curve is that

where prices are set by Medicare on assigned claims.  In this model the length

of the component $A_1B_1$ is assumed to be determined by the demand of individuals

facing the coinsurance and deductibles on Medicare allowed charges (i.e., the

demand of beneficiaries facing an out-of-pocket price of $Pm_1^*$).  Since

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5. Physicians are paid on the basis of the lower of actual charges, customary
   or prevailing charges--the 75th percentile of area customary charges unless
   constrained by the Medicare economic index.  Because the Medicare economic
   index has been increasingly constraining over time, the prevailing charge
   index is a reasonable measure of average allowed charges in the area.  The
   actual charge billed by the physician may be substantially higher and is
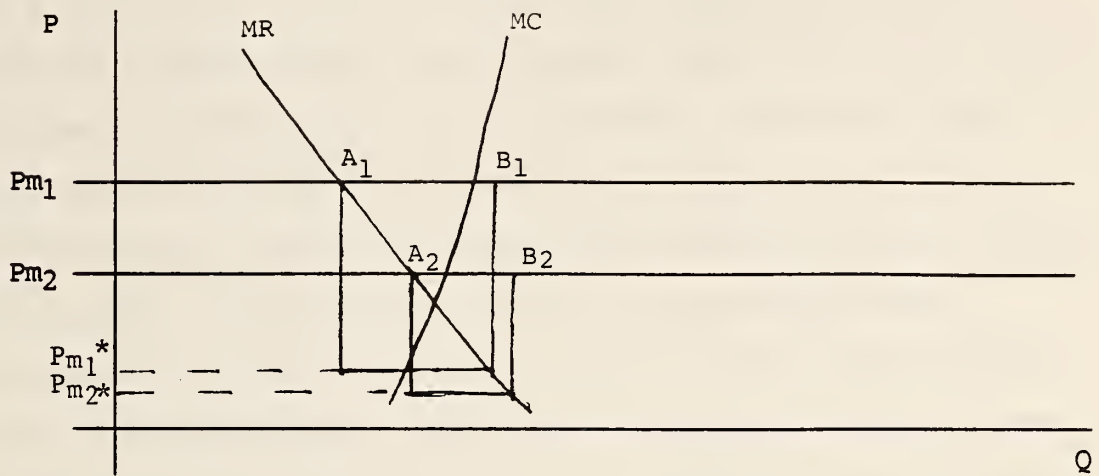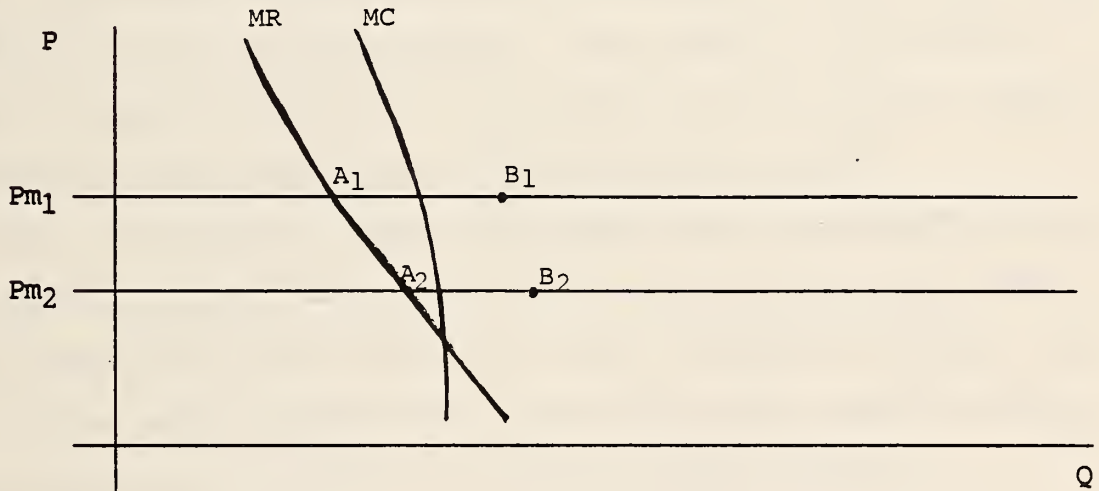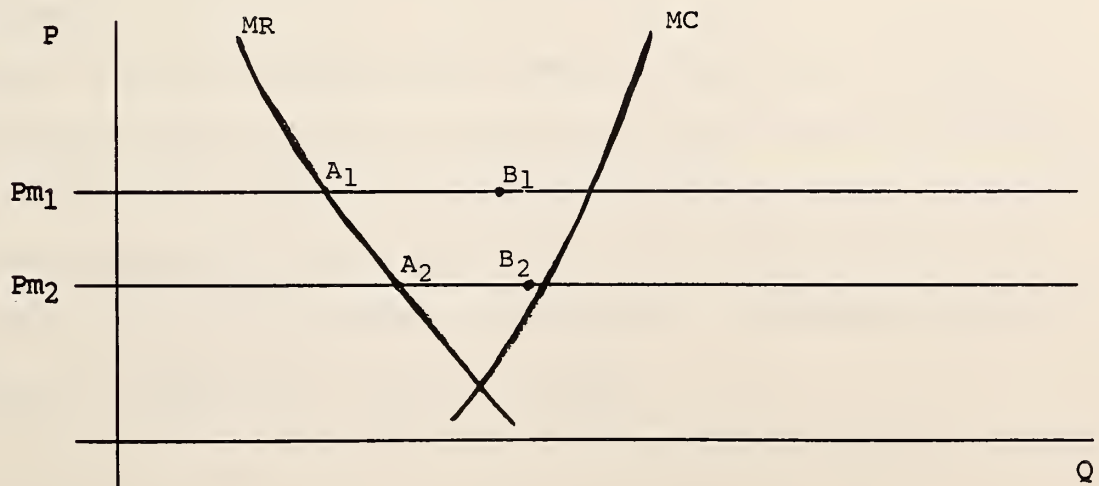   only the price faced by the physician on nonassigned claims.

FIGURE 1

FIGURE 2

FIGURE 3

deductibles and coinsurance along with individuals' limited willingness to consume an unending amount of medical services place some natural limit on the amount of care people demand, $A_1B_1$ cannot be infinite. In the first model we assume that the assigned portion of the demand curve, while limited by the demand for services, $A_1B_1$, exceeds the amount physicians are willing to supply at this Medicare rate. We also assume positively sloped supply curves.

In the second model, shown in Figure 2, we have the same type of demand curve but assume a backward-bending supply curve. In Figure 3 we again have the same type of demand curves but we change the assumption of excess demand. In this model, the amount of both nonassigned and assigned demand is less than the amount physicians are willing to supply. This reflects the fact that in many markets the supply of physicians is such that they are willing to supply more services at Medicare reimbursement rates than patients demand.

The issue is how changes in prevailing charges would operate under each of these three models. In each model, a reduction in prevailing charges reduces the price to beneficiaries and to physicians; thus, a movement from $Pm_1$ to $Pm_2$. In Model 1 the fee reduction would lead to reduction in the supply of services because physicians are less willing to provide services to Medicare beneficiaries at lower real prices. The fact that beneficiaries may demand more is irrelevant.

In Model 2 the price reduction would result in increased utilization because physicians would move down the supply curve and increase the amount of services provided. As a result real physician expenditures go up because of a supply response; demand is considerably greater than supply initially and remains so after the price reduction. In this model, the response to the fee freeze cannot be interpreted as a demand response.

In Model 3 the price reduction reduces the out-of-pocket costs to consumers because the coinsurance on the lower Medicare allowed charges is correspondingly lower. In this model the response to the fee freeze should be interpreted as a demand response. (Note that $A_2Pm_2 > A_1Pm_1$.) But the model demonstrates that there can only be a demand response if there is excess supply at Medicare reimbursement rates.

These alternative models make it difficult to establish a priori predictions. The response to price may be negative because of either demand or supply responses, or positive. Depending on the elasticities of demand and supply with respect to price, responses may also be close to zero. While we would like to estimate a structural demand curve, we acknowledge that different types of markets are likely to exist in the U.S.; as a result we conclude that interpretation of the price variable requires considerable caution.

The next set of variables in the demand equation is a set of demographic characteristics. These include the age, sex, and race composition of the elderly population, e.g., percentage of the population under 65, percent greater than 65, percent between 65 and 74, percent 75 to 84, percent 85 and over, percent male, percent white, etc. We also decompose the area Medicare population into old age, disabled, and renal disease beneficiaries. The age and disabilities/renal failure variables serve as proxies for health status. Health status is expected to decline with increasing age; likewise, the higher the proportion of the population that is disabled or with renal failure, the higher utilization is likely to be. We have also controlled for the mortality rate of the Medicare population. The variable is defined as the mortality rate of the area Medicare population in the previous year to avoid the obvious endogeneity problem. We also include in the demand equation the ratio of Medicare HMO enrollees to total enrollees. Since it is frequently alleged that

HMOs have tended to enroll healthier Medicare enrollees, this variable may also be a proxy for health status.

The next set of variables are specialists per capita and general practitioners per capita. In general, we would expect that the greater the availability of physicians the greater the utilization or real expenditures in the area, particularly for areas with higher ratios of specialists to population. Interpreting this variable is not straightforward, however (1,2). The increasing supply of specialists can lead to greater access for beneficiaries, lowering time costs, and increasing amenities and other proxies for quality. Thus, beneficiaries may increase demand in response to access and quality. Alternatively, increasing supplies of specialists increase market place competition. If physicians, as alleged, are able to influence patients' demand for services, real expenditures would increase in response to higher levels of physician supply.[6] Finally, specialists have superior training and greater access to newer procedures and more modern technologies. Because of such access, utilization may also be higher where the number of specialists per capita is greater.

The hypotheses for the ratio of general practitioners to population are somewhat different. While utilization should also be positively related to the availability of general practitioners because of the time/price and induced demand arguments, it may be lower because of more limited access to newer procedures/technologies. Thus, our a priori expectations on the general practitioner variable is much less clear. In general, we would expect real expenditures to be less positively related to the supply of general practitioners, or perhaps negative.

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6. Each of the models described above is consistent with the inducement view; however, one would not expect to find inducement of assigned services in markets characterized by excess demand.

We include an index of malpractice premiums to measure the malpractice risk to physicians. Since malpractice premiums will be higher in the areas with more claims, the variable is a measure of physician response, e.g., defensive medicine. The malpractice variable should be positively related to utilization if physicians produce additional services to reduce the probability of malpractice claims. But they may provide fewer services if the risk of claims is greater. The malpractice premium is in this sense a demand shift variable. Malpractice premiums will also affect physician fees as reflected in prevailing charges; thus malpractice will affect volume and intensity of services directly and indirectly through its effect on price, which in turn affects utilization.

Hospital admissions and lengths of stay play a key role in affecting the demand for services. We test formally whether our admission rates and lengths of stay lead to higher utilization of physician services. Generally, we would expect admission rates and lengths of stay to be positively related to care provided in inpatient settings, but perhaps negatively related to care provided in office, outpatient, and other settings. The net effect is unclear. The answer to this question is at the core of this study.

Next, we control for whether or not the area hospitals were under the PPS system during the years of the study. This is a measure of whether there was a residual effect of the PPS system on real physician expenditures over and above the effects on admissions and lengths of stay.

Finally, we include a measure of teaching capacity. The variable is the ratio of hospital-based physicians to population, largely a measure of the presence of interns and residents in the geographic area. We intend this variable to be a proxy for the availability of new technologies and expect it to be positively related to the use of services, particularly in inpatient

settings. The variable, however, also captures the availability of interns and residents as a substitute for private physicians. To the extent interns and residents provide physician services, this care will be billed as a hospital expense and covered directly through the PPS system. To the extent interns and residents substitute for private physicians, there could be a reduction in Part B expenditures.

Although we estimate only the demand function, the specification of the supply function is important, since it determines which additional exogenous variable will enter into the first-stage estimates. Therefore, it is useful to present the hypotheses generated about supply of physician services in the area. We posit a supply function which measures the willingness of physicians to provide services to the Medicare market:

$$(11) \quad Q_S = (P, GMEI, INCPOP, UNEM, ENR, BEDS, STAFF, SPEC, GP, MAL)$$

where  $Q_S$ = quantity supplied
   GMEI = the area physician cost of practice index
  INCPOP = income per capita for entire area population
    UNEM = area unemployment rate
     ENR = the proportion of total population enrolled in Medicare
   BEDS = hospital beds per capita
  STAFF = hospital staff per bed

Thus, quantity supplied is posited as a function of price (again the prevailing charge index), the costs of practice index (GMEI), hospital beds per capita, hospital staff per bed, income per capita and employment rates in the area, and the proportion of area population enrolled in Medicare. The quantity supplied should be positively related to price and inversely related to the geographic costs of practice index. It also should be positively related to the availability of hospital beds and to the number of hospital staff per bed

because these complementary inputs permit physicians to extend their productivity, and thus produce a greater quantity of services, holding price constant. The quantity supplied should be negatively related to income per capita (greater non-Medicare demand) and positively related to unemployment rates (less non-Medicare demand). Next, the quantity supplied should be positively related to Medicare enrollment in the area. The physician supply variables should be positively related to the supply of services because the physician's time is perhaps the major factor affecting costs of services. The more competition from other physicians in the area, the lower the opportunity cost of the physician's time and the greater the supply of services. Finally, malpractice premiums will directly affect the cost of practice and, thus, the locus of the supply curve.

## Specification of Partial Adjustment Model

We have argued that the demand for physician services in the area depends, in part, on the volume of inpatient services. However, in late 1983 a "shock" was introduced to the inpatient market in the form of PPS. It is reasonable to expect that there will be some lag in the adjustment to this shock in the market for inpatient services, and indirectly, in the market for physician services. In addition, the physician services market may exhibit a lag in response to changes in inpatient volume (length of stay, hospital admissions) or changes in other demand factors.

We have chosen to use a partial adjustment model to analyze the process of change between 1983 and 1985. Algebraically, we can write this model in the following manner:

(12) $\quad Q^{*85} = a_o + b_1 Y + b_2 PPS + b_3 ZZ$

where $Q^{*85}$ is the "equilibrium" volume of services patients would consume in
1985 and $a_0$, $b_1$, $b_2$, and $b_3$ are parameters to be estimated. The remaining
variables include Y, which is equal to measures of hospital utilization-
-admission rates and lengths of stay; PPS is an indicator variable for whether
the area was under the PPS system; and Z stands for all other variables in the
model.

According to the partial adjustment framework, we posit that

$$(13) \qquad Q_{85} - Q_{83} = p \ (Q^*_{85} - Q_{83})$$

$Q_{85}$ and $Q_{83}$ are the actual volumes of services observed in 1985 and 1983. The
expression on the left-hand side is the actual change in volume between 1985
and 1983. $Q^*_{85}$ is the desired level of volume in 1985. Equation (13) states
that the actual change is some proportion of the desired change. Since $Q^*_{85}$ is
never observed, it is necessary to substitute equation (12) into equation (13))
to derive an expressing for $Q_{85}$ that is only a function of observed variables.
We then arrive at equation:

$$(14) \qquad Q_{85} - Q_{83} = p(a_0 + b_1 Y + b_2 PPS + b_3 Z - Q_{83})$$

or

$$(15) \qquad Q_{85} = (1-p) \ Q_{83} + pa_0 + pb_1 Y + pb_2 PPS + pb_3 Z$$

Equation (15) states that the volume observed in 1985 is a function of the
volume in 1983 and the set of other exogenous and endogenous variables. The
coefficient on $Q_{83}$ suggests that the adjustment in 1985 is complete only if p
is not significantly different from 1, or (1-p) not significantly different

from zero; in this case, the lagged term $Q_{83}$ is of no importance. The long-term effect of each variable on the equilibrium value of the level of volume can be determined by dividing each coefficient by p.[7]

The model can be used to estimate the effects of each variable on change between 1985 and 1983. We can derive the pure policy effect of, say, PPS on the utilization of physician services between 1983 and 1985 by using the following procedure. Remember that PPS will have both an indirect and direct effect on physician services (i.e., it will affect inpatient volume—lengths of stay and possibly admission rates—and these in turn will affect physician use). By estimating partial adjustment equations, similar to those described above, for admissions and lengths of stay, we can then calculate the effect of PPS on admissions and lengths of stay. The indirect effect of PPS on changes in physician service volume will be the sum of the effects of PPS on admissions and lengths of stay, multiplied in turn by the effects of admissions and lengths of stay on changes in service volume. To these indirect effects we can add the direct effect of the PPS as obtained from the coefficient in equation (15). Similar simulations can be conducted for other variables, such as increases in assignment rates, changes in physician specialty composition, etc.

Partial adjustment models have considerable advantages over first difference or cross-sectional equations in estimating the effect of changes in events such as PPS. In a first difference or pure change model, one implicitly assumes that an adjustment toward an equilibrium has not begun in the time period being observed. The equation picks up the effect of the real change

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7. As the model has been estimated, these long-term effects will be overstated. The reason for this is that the coefficient of $Q_{83}$, 1-p, will be biased upward by capturing area-specific effects that are not otherwise controlled for in the regression. If a longer panel of data for each area were available, this problem could be corrected by estimating a fixed effects model. Note, however, that it is only the coefficient (1-p) that is likely to be biased, not the other coefficients in the model.

plus random fluctuations in both the dependent and explanatory variables. This explains the low explanatory power frequently observed in such regressions. On the other hand, cross-sectional models are typically not helpful in understanding the impact of changes because they implicitly assume that an adjustment to equilibrium is complete. This is a strong assumption during a short time period in which major changes have taken place. Cross-sectional equations are more likely to capture only the correlation between a dependent variable and a policy change such as PPS, not the policy's impact on a new equilibrium.

The partial adjustment model uses cross-sectional variation to analyze the process of change to equilibrium levels. The effects of variables on this process can be observed because the effects on the base year level of the dependent variable are held constant. Thus, the effects of PPS can be measured. The results are unbiased because the partial adjustment framework allows the adjustment to equilibrium to begin but does not require it to be completed.

The unit of analysis, as noted, is the MSA or the non-MSA parts of each state. This introduces the likelihood of heteroskedasticity. Essentially, the more beneficiaries in the area, the smaller the variance. In a regression using grouped data in which the size of groups varies, the ordinary least squares procedure will yield unbiased parameter estimates, but it will also be inefficient (i.e., it will not yield the minimum variance estimates). This problem can be overcome by using a weighted least squares procedure, which assigns weights that are proportional to the underlying population size. In this study, the weight chosen was the square root of the number of Medicare enrollees in the MSA or rural area; areas with larger Medicare populations receive larger weights.

## V.  REGRESSION RESULTS

The results of the partial adjustment model are presented in Tables 5 and 6.  The dependent variable is real Medicare expenditures per enrollee in 1985. Table 5 presents the results by place of care, while Table 6 presents the results by type of care.  Table 7 provides short-term elasticities from the partial adjustment model.  Table 8 gives the estimated effects of most variables on the growth in Medicare expenditures over the 1983-1985 period.

The first variable of interest is the coefficient on the level of real expenditures in 1983.  That coefficient ranges from .21 to .78 in the place of care regressions and from .34 to .69 in the type of care regressions.  This coefficient in partial adjustment models normally ranges between zero and 1.00, varying inversely with the speed of adjustment to new equilibrium levels.  The value .21 in the inpatient regression, for example, indicates a very fast adjustment to the changes that occurred during this period.  That is, the level of expenditures in 1985 are relatively close to their equilibrium levels.  This is consistent with the findings of the Hadley, Zuckerman and Feder (5) who showed that hospitals could adjust their behavior rapidly to the financial incentives in PPS.  A higher coefficient, such as the .78 in the outpatient regression, means that most of the adjustment has yet to occur.  That is, the long-term elasticities are substantially greater than the short-term elasticities.  Stated differently, the effects that we observe between 1983 and 1985 are only a small part of what might be expected before equilibrium is reached, particularly for office based and outpatient care.

## Table 5

Regression Results: Real Medicare Physician Expenditures per Enrollee in 1985,
by Place of Care

### Partial Adjustment Model

|  | Total | Inpatient | Office | Outpatient | Other |
|---|---|---|---|---|---|
| Intercept | -12756.60*<br>(-1.72) | -6725.91<br>(-1.41) | -7825.10***<br>(-2.82) | 2353.24<br>(1.27) | -1268.66<br>(-0.59) |
| UNDER 65 | 27.98*<br>(1.77) | 30.17***<br>(2.97) | 5.17<br>(0.85) | 0.81<br>(0.20) | 2.56<br>(0.64) |
| AGE 65-74 | 19.09***<br>(3.78) | 18.01***<br>(5.52) | 1.66<br>(0.86) | -0.36<br>(-0.29) | 1.51<br>(0.80) |
| AGE 75-84 | 32.31***<br>(4.40) | 23.64***<br>(4.96) | 5.82**<br>(2.12) | -1.25<br>(-0.69) | 5.38***<br>(2.92) |
| PCT MALE | 16.33***<br>(5.34) | 6.82***<br>(3.53) | 4.00***<br>(3.39) | -0.08<br>(-0.11) | 2.71***<br>(3.58) |
| PCT BLACK | -1.21*<br>(-1.85) | -0.52<br>(-1.25) | -0.26<br>(-1.06) | 0.11<br>(0.65) | -0.44***<br>(-2.67) |
| MORTALITY | 44.12***<br>(3.55) | 40.74***<br>(5.15) | -0.01<br>(-0.00) | 10.36***<br>(3.23) | 0.01<br>(0.00) |
| PCT DIS | 86.76<br>(1.18) | 28.66<br>(0.61) | 70.70***<br>(2.58) | -24.49<br>(-1.34) | 7.93<br>(0.44) |
| PCT OAS | 99.29<br>(1.32) | 45.04<br>(0.94) | 73.67***<br>(2.63) | -22.65<br>(-1.21) | 9.16<br>(0.49) |
| *PREVAILING CHARGE INDEX* | -37.43<br>(-1.16) | -16.65<br>(-0.82) | 22.03*<br>(1.83) | -24.05***<br>(-2.96) | -16.17**<br>(-2.00) |
| *ASSIGNMENT RATE* | 81.01***<br>(3.05) | 4.35<br>(0.28) | 22.74**<br>(2.42) | 16.05**<br>(2.07) | 87.29***<br>(6.86) |
| INSURANCE | 0.46<br>(0.71) | 0.19<br>(0.46) | 0.28<br>(1.12) | -0.47***<br>(-2.84) | 0.10<br>(0.60) |
| *ADMISSION RATE* | 133.15**<br>(2.47) | 192.75***<br>(5.43) | -24.83<br>(-1.23) | 21.65<br>(1.58) | -9.48<br>(-0.71) |
| *LOS* | 10.44***<br>(2.68) | 12.49***<br>(4.99) | 2.22<br>(1.49) | -2.06**<br>(-2.04) | -0.79<br>(-0.79) |
| PPS | 22.25<br>(1.56) | 3.65<br>(0.40) | 7.29<br>(1.35) | 10.06***<br>(2.69) | 2.35<br>(0.66) |

Table 5 (continued)

|  | Total | Inpatient | Office | Outpatient | Other |
|---|---|---|---|---|---|
| *GP/POP* | -159.93<br>(-2.34) | -27.63<br>(-0.64) | -81.76***<br>(-3.11) | -17.79<br>(-1.02) | -6.18<br>(-0.36) |
| *SPEC/POP* | 28.04*<br>(1.74) | 2.62<br>(0.25) | 8.77<br>(1.42) | 7.00*<br>(1.69) | -0.09<br>(-0.02) |
| INCOME | 1.14E-02***<br>(3.27) | 4.12E-03*<br>(1.85) | 4.63E-03***<br>(3.54) | 6.39E-04<br>(0.70) | 7.28E-04<br>(0.83) |
| MALPRACTICE | -2.01E-03<br>(-1.46) | -1.70E-03*<br>(-1.93) | -1.30E-03**<br>(-2.56) | -6.05E-04*<br>(-1.72) | 6.98E-04**<br>(2.11) |
| HMO PER<br>ENROLLEE | 2.31***<br>(3.29) | 1.51***<br>(3.35) | 0.50*<br>(1.90) | 0.49***<br>(2.70) | -0.24<br>(-1.36) |
| TEACHING | -34.28*<br>(-1.86) | -25.69**<br>(-2.17) | 4.71<br>(0.67) | -12.04**<br>(-2.56) | 0.82<br>(0.18) |
| METRO SM | -13.76<br>(-0.84) | -20.70**<br>(-2.00) | -7.53<br>(-1.21) | -2.66<br>(-0.64) | 11.47***<br>(2.78) |
| METRO MD | 9.22<br>(0.60) | -7.51<br>(-0.76) | -3.30<br>(-0.56) | -1.44<br>(-0.36) | 12.21***<br>(3.15) |
| METRO LG | 32.85*<br>(1.74) | 10.06<br>(0.84) | -6.47<br>(-0.90) | 0.58<br>(0.12) | 12.81***<br>(2.72) |
| EXP-1983 | 0.37***<br>(11.34) | 0.21***<br>(6.19) | 0.77***<br>(24.11) | 0.78***<br>(10.41) | 0.50***<br>(3.41) |
| $R^2$ | 0.73 | 0.58 | 0.88 | 0.62 | 0.38 |
| F | 32.74 | 16.96 | 86.3 | 19.63 | 7.30 |

Note: Variables in italics are instrumental variables estimated using two-stage least squares procedures.

* Significant at .10 level.
** Significant at .05 level.
*** Significant at .01 level.

Table 6

Regression Results: Real Medicare Physician Expenditures per Enrollee in 1985,
by Type of Care

Partial Adjustment Model

|  | Total | Medical Care | Surgery | Radio-logy | Consul-tation | Other |
|---|---|---|---|---|---|---|
| Intercept | -12756.60* | -9652.82*** | 5387.15* | -5563.02*** | -674.86 | -3865.15 |
|  | (-1.72) | (-2.61) | (1.92) | (-3.54) | (-1.42) | (-1.42) |
| UNDER 65 | 27.98* | 1.37 | 10.94* | -0.15* | 0.49 | 9.14 |
|  | (1.77) | (0.17) | (1.80) | (-0.04) | (1.16) | (1.54) |
| AGE 65-74 | 19.09*** | 5.02* | 8.15*** | -0.45 | 1.16*** | 3.74** |
|  | (3.78) | (1.93) | (4.30) | (-0.43) | (3.33) | (1.98) |
| AGE 75-84 | 32.31*** | 5.72 | 11.86*** | -1.31 | 1.60*** | 9.43*** |
|  | (4.40) | (1.54) | (4.25) | (-0.87) | ((3.22) | (3.45) |
| PCT MALE | 16.33*** | 1.15 | 3.96*** | 2.17*** | 0.36* | 5.84*** |
|  | (5.34) | (0.76) | (3.43) | (3.41) | (1.80) | (4.99) |
| PCT BLACK | -1.21* | -0.30 | -0.26 | -0.06 | 0.01 | -0.50** |
|  | (-1.85) | (-0.92) | (-1.02) | (-0.40) | (0.19) | (-2.06) |
| MORTALITY | 44.12*** | 11.63* | 15.86*** | 7.52*** | 0.90 | 3.98 |
|  | (3.55) | (1.88) | (3.31) | (2.77) | (1.10) | (0.86) |
| PCT DIS | 86.76 | 93.04** | -68.46** | 53.96*** | 5.84 | 27.36 |
|  | (1.18) | (2.55) | (-2.46) | (3.49) | (1.23) | (1.01) |
| PCT OAS | 99.29 | 91.23** | -62.80** | 54.85*** | 5.25 | 30.93 |
|  | (1.32) | (2.44) | (-2.21) | (3.47) | (1.09) | (1.12) |
| PREVAILING CHARGE INDEX | -37.43 | -4.54 | -25.00** | -17.93*** | 3.91* | 6.68 |
|  | (-1.16) | (-0.30) | (-2.35) | (-3.78) | (1.93) | (0.56) |
| ASSIGNMENT RATE | 81.01*** | 64.54*** | -12.84 | 24.48*** | 1.80 | -21.34** |
|  | (3.05) | (4.48) | (-1.43) | (4.81) | (9.91) | (-2.22) |
| INSURANCE | 0.46 | -0.13 | -0.30 | 0.21 | 0.05 | 0.47* |
|  | (0.71) | (-0.39) | (-1.20) | (1.55) | (1.06) | (1.94) |
| ADMISSION RATE | 133.15** | 57.07** | 56.59*** | -4.69 | 4.89 | 0.09 |
|  | (2.47) | (2.10) | (2.71) | (-0.41) | (1.37) | (0.01) |
| LOS | 10.44*** | 5.20*** | -2.11 | 1.84** | 1.06*** | 4.66*** |
|  | (2.58) | (2.65) | (-1.40) | (2.07) | (4.00) | (3.19) |
| PPS | 22.25 | -7.10 | -3.47 | 13.86*** | -1.77* | 10.32* |
|  | (1.56) | (-1.00) | (-0.63) | (4.40) | (-1.87) | (1.87) |

Table 6 (continued)
Page 2

| | Total | Medical Care | Surgery | Radio-logy | Consul-tation | Other |
|---|---|---|---|---|---|---|
| *GP/POP* | -159.934** (-2.34) | 3.18 (0.09) | -34.48 (-1.33) | -29.29** (-2.05) | -3.29 (-0.72) | -63.91** (-2.49) |
| *SPEC/POP* | 28.04* (1.74) | 13.62* (1.68) | 2.80 (0.45) | -2.59 (-0.76) | 2.26** (2.11) | 11.47* (1.90) |
| INCOME | 1.14E-02*** (3.27) | 6.09E-03*** (3.49) | 1.15E-03 0.86 | 2.99E-03*** (3.91) | 4.91E-04** (2.12) | -2.30E-04 (-0.18) |
| MALPRACTICE | -2.02E-03 (-1.46) | -1.28E-03 (-0.21) | -2.06E-04 (-0.38) | -1.58E-04 (-0.62) | -3.02E-04*** (-3.67) | -1.48E-03*** (-2.90) |
| HMO PER ENROLLEE | 2.31*** (3.29) | 1.16*** (3.30) | 0.30 (1.12) | 0.03 (0.18) | 0.19*** (3.98) | 0.72*** (2.71) |
| TEACHING | -34.28* (-1.86) | -16.37* (-1.79) | -7.42 (-1.05) | 3.48 (0.89) | -1.48 (-1.20) | -6.75 (-0.98) |
| METRO SM | -13.76 (-0.84) | -24.71*** (-3.06) | 3.57 (0.57) | 1.29 (0.37) | -2.44** (-2.27) | 2.97 (0.48) |
| METRO MD | 9.22 (0.60) | -11.04 (-1.44) | 7.44 (1.25) | 2.46 (0.74) | -1.78* (-1.74) | 4.98 (0.86) |
| METRO LG | 32.85* (1.74) | -6.95 -0.75 | 14.17** (1.97) | 8.59** (2.17) | -1.25 (-1.00) | 6.05 (0.85) |
| EXP-1983 | 0.37*** (11.34) | 0.34*** (7.60) | 0.35*** (8.12) | 0.66*** (16.05) | 0.69*** (20.20) | 0.59*** (14.27) |
| $R^2$ | 0.73 | 0.67 | 0.61 | 0.73 | 0.88 | 0.68 |
| F | 32.74 | 24.62 | 18.93 | 32.02 | 90.92 | 26.31 |

Note:  Variables in italics are instrumental variables estimated using two-stage least squares procedures.

*    Significant at .10 level.
**   Significant at .05 level.
***  Significant at .01 level.

Table 7

Short-Run Elasticities in Partial-Adjustment Models

| | | Type of Care | | | | | Place of Care | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Medical Care | Surgery | Radiology | Consultations | Other (Type) | Inpatient | Office | Outpatient | Other (Place) |
| PREVAILING CHARGE INDEX | -.07 | -.02 | -.14** | -.32*** | .20* | .08 | -.06 | .13* | -.39*** | -.65** |
| ASSIGNMENT RATE | .09*** | .19*** | -.04 | .25*** | .06 | -.15** | .009 | .07** | .17** | 2.75*** |
| ADMISSION RATE | .08** | .10** | .11*** | -.03 | .08 | .000 | .23*** | -.05 | .11 | -.13 |
| LOS | .16*** | .22*** | -.10 | .26*** | .46*** | .47*** | .37*** | .11 | -.27** | -.27 |
| GP/POP | -.06** | .003 | -.04 | -.10** | -.04 | -.16** | -.02 | -.10*** | -.06 | -.05 |
| SPEC/POP | .05* | .07* | .02 | -.04 | .12** | .14* | .009 | .05 | .11* | -.004 |
| INCOME | .23*** | .34*** | .07 | .55*** | .28** | -.03 | .16* | .31*** | .11 | .32 |
| MORTALITY | .37*** | .27** | .40*** | .57*** | .21 | .22 | .65*** | .000 | .74*** | .000 |
| HMO | .02*** | .02*** | .006 | .002 | .04*** | .03*** | .02*** | .01* | .03*** | -.04 |
| MALPRACTICE | -.02 | -.04 | -.007 | -.02 | -.10*** | -.11*** | -.04* | -.05** | -.06* | .17** |

* Significant at .10 level.

** Significant at .05 level.

*** Significant at .01 level.

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Table 8

Estimated Effects of Selected Variables on Medicare
Physician Service Volume Growth

| | Absolute Dollar Change, 1983–1985, in Real Expenditures per Enrollee | Percentage Change, 1983–1985, in Real Expenditures per Enrollee |
|---|---|---|
| Total Increase | $ 56.23 | 10.60% |
| Admission Rates[a] | −6.10 | −1.20 |
| Length of Stay[a] | −10.40 | −2.00 |
| Prospective Payment System (A)[b,c] | | |
|   Full Effect | 9.35 | 1.80 |
|   Through Admissions | 0.30 | 0.00 |
|   Through Length of Stay | −13.20 | −2.50 |
|   Direct Effect | 22.25 | 4.20 |
| Prospective Payment System (B)[b,c] | | |
|   Full Effect | 10.10 | 1.90 |
|   Through Admissions | −5.05 | −1.00 |
|   Through Length of Stay | −7.10 | −1.30 |
|   Direct Effect[d] | 22.25 | 4.20 |
| Assignment Rates | 14.70 | 2.80 |
| Malpractice Rates[d] | −2.40 | −0.50 |
| Physician Supply | 0.50 | 0.10 |
|   Specialists | 1.30 | 0.25 |
|   General & Family Practitioners | −0.80 | −0.15 |
| Income | 15.30 | 2.90 |
| Fee Freeze[d] | 3.60 | 0.70 |
| Change in Age Distribution | 2.10 | 0.40 |
| HMO Enrollment Growth | 3.60 | 0.70 |

a. These represent the estimated full effects of declines in admissions and lengths of stay on real expenditures. The effects of PPS include estimates of the impact of prospective payment on expenditures through its effect on admissions and lengths of stay. While PPS may have contributed, both admissions and lengths of stay also fell for reasons unrelated to PPS.

b. The estimated direct effect of PPS on real expenditures is not quite statistically significant, yet it is large in magnitude. Since it more than offsets the significant indirect effects through declines in admissions and lengths of stay, our conclusion is that PPS probably had a small positive effect.

c. These computations were based on two different approaches to estimating the PPS impact. The first approach (A) uses our own econometric estimates. The second (B) uses data provided by the Health Care Financing Administration.

d. These results were computed on the basis of results which were not statistically significant. All other results were significant at at least the .10 level.

## Admissions and Lengths of Stay

The first important results for this study are those on hospital utilization statistics. The regression results suggest that the admission rate is positively related to the level of real expenditures for all services in 1985, with the result statistically significant at the .05 level. We estimate that the short-run elasticity of total real physician expenditures with respect to admissions to be .08. Thus, as a result of declines in admissions, we estimate that total real physician expenditures were about 1.2 percent lower in 1985 than they otherwise would have been. The admission rate is positively related to inpatient spending, with a short-run elasticity of .10. Because Medicare admissions fell during this period, real inpatient physician expenditures were lower than they otherwise would have been. The admission rate variable is not significant in any of the other site of care regressions, meaning that while physician services in inpatient settings declined during this period as admission rates declined, there was not an increase in care provided in other settings to offset this. As a result, there was a decrease in total real spending due to declining admission rates. In the type of service equations, the admission rate is positive and significantly related to real medical care and surgery expenditures in 1985.

Lengths of stay are also significant (at the .01 level) and positively related to overall real expenditures; the estimated elasticity was .16. We estimate that real physician expenditures were 2.0 percent less than they otherwise would have been, because of the decline in lengths of stay between 1983 and 1985. Not surprisingly, this effect is felt in the inpatient physician expenditure regressions. That is, as lengths of stay have fallen, real expenditures for care provided in an inpatient setting have declined; the estimated elasticity was .37. The length of stay variable is negative and

significant in the outpatient regression, indicating that physician services in outpatient departments have increased as lengths of stay have fallen. Length of stay was not significant in the remaining site of care regressions. The net effect is that while real inpatient expenditures have declined, there has not been an offsetting increase in care provided in other settings. Thus, the total effect is one of reduced physician expenditures. The type of service regressions indicate that as lengths of stay have fallen, medical care, radiology, consultation, and other types of services have all declined

## Prospective Payment (PPS)

Medicare's Prospective Payment System was partially responsible for the decline in Medicare lengths of stay and perhaps admissions. We calculated the full effect of PPS on real expenditures by first estimating its effect on hospital admissions and lengths of stay. We then used the product of the impact on admissions and lengths of stay, together with the effect of these variables on physician services. Our regression results (not reported here) indicate that PPS had no effect on Medicare admissions but reduced lengths of stay by 14.7 percent or 1.3 days. Thus, our estimated indirect effect of PPS on physician services was 2.5 percent decline in real expenditures because of the effect of PPS on lengths of stay.

Because our econometric results differ from HCFA data on changes in Medicare admissions and lengths of stay in PPS and waiver states, we also computed the impact of PPS using an alternative assumptions of its effect on Medicare admissions and lengths of stay. Essentially, we assume that the declines in Medicare admissions and lengths of stay in waiver states would have occurred in the other states in the absence of PPS; we then attributed the difference between waiver and PPS states to PPS. Under these assumptions, Medicare admission rates fell by 9.2 percent and lengths of stay by 7.8 percent

due to PPS. Based on these estimates of PPS impacts, we compute the indirect effects of PPS on physician volume (real expenditures) to be a 1.0 percent decrease due to declines in admissions and 1.3 percent decrease due to reductions in lengths of stay.

We also included a PPS binary variable to capture any direct effects due to the introduction to the Prospective Payment System other than that occurring through changes in admissions and lengths of stay. The variable captures differences between PPS and waiver states; the comparison is appropriate because the latter states did not have PPS and, in addition, their systems did not change during this period. In the total services regression, the PPS variable was positive but not significant (t-statistic = 1.56); the coefficient indicated real expenditures were $22.25 higher in PPS states, all else being equal. The results indicated that the PPS variable was significant and positive in the radiology and other type of service equations, but negative in the consultation regression. We also found a significant and positive effect on care provided in outpatient settings. The PPS variable was positive but not significant in the office regression (t-ratio = 1.35). These results, taken together, indicate that PPS may have resulted in increased diagnostic testing, i.e., radiology and laboratory services, in outpatient departments and physicians offices. Though the result is not quite significant at the .10 level, it suggests PPS may have had a positive direct effect on Part B physician services during this period.

The PPS effect in the radiology equation is highly significant and is quite important for policy reasons. (The PPS effect in the other services equation is less significant but also important.) During this period, all hospitals including those in the waiver states were required to end combined billing practices. Instead, hospitals were required to cover the technical

component of radiology and laboratory services as hospital costs paid through the PPS system and bill the professional component of radiology and laboratory services to Part B of Medicare. While hospitals in all states faced this requirement, only those under the PPS system faced an additional incentive to move all radiology and laboratory services out of the hospital. To the extent radiology and laboratory services could be provided outside the hospital, hospital costs would be lower because they would no longer provide the technical component of the service; correspondingly, Part B expenditures would increase. Our findings suggest that the latter has in fact occurred.

The full effect of PPS depends on the impact on admissions and lengths of stay and their effect, in turn, on real expenditures, plus the direct PPS effect on expenditures. We estimate the full PPS effect in two ways. First, as described above, we use our admission and length of stay regression estimates to calculate the indirect effects on real expenditures; we then added the direct PPS coefficient to obtain the full effect. The second set of estimates uses the alternative assumptions of a 9.2 percent decline in admissions and a 7.8 percent decline in lengths of stay; and again we add the direct PPS effect. Under the first scenario, real expenditures increased by about 1.8 percent. Under the second scenario, real expenditures increased by 1.9 percent. However, we caution that the increase in both cases is solely due to the impact of the direct effect which, while large in magnitude, is not quite statistically significant.

## Price Variables

The next set of variables of interest are three price variables. As indicated in the previous section, we include an index of prevailing charges, the assignment rate, and the proportion of Medicare beneficiaries with private insurance or Medicaid to measure various aspects of the prices facing

beneficiaries. The prevailing charge index is negative (t-ratio = -1.16) in the all-services equations, with an elasticity of -.07. The variable is significant in several of the individual type and place of service analyses. The results can be used to examine the effect of the fee freeze imposed in July 1983. Our findings imply that the fee freeze had only a very small effect on the volume and intensity of care as measured by our real expenditure variable. Medicare prices were frozen during the last 18 months of the 1983-1985 period, while the Medicare economic index increased by 9.4 percent. Our best estimate is an increase in real expenditures (volume) of about $4 or 0.7 percent above what they would have been in the absence of a freeze. However, because the volume increase (in percentage terms) was much less than what the fee increase would have been, the fee freeze was successful in lowering Medicare expenditures.

The prevailing charge index variable is positive and significant at the .10 level in the office regression, but negative and significant in the outpatient and other site of care regressions. The prevailing charge index variable was negative in the radiology and surgery regressions with elasticities of -.14 and -.32, respectively. The price variable was positive in the consultation regression with an elasticity of .20. As noted in the previous section, we interpret the price variables with caution because of the difficulty in interpreting them clearly as demand responses as opposed to changes in the willingness of physicians to supply services. The negative coefficients are significant with both a demand response (in markets with excess supply) or with a supply response (in markets with excess demand but backward-bending supply curves). The positive response in consistent only with movement along a positively sloped supply curve in a market with excess demand. While difficult to interpret, these results do suggest that the volume of

surgical and radiological procedures and services provided in outpatient departments increased in response to the physician fee freeze. In contrast, consultations and services in the office appear to have declined. The net effect, if any, is a small increase in volume in response to the fee freeze.

The effect of the assignment rate variable, however, seems unambiguous. It is positive and significant overall and in most individual regressions with the exception of surgery and consultations. The assignment rate variable is also positive and significant in the office, outpatient, and other site of care regressions. During the 1983-1985 period, assignment rates increased by about 30 percentage points. The results indicate that the higher the assignment rate the higher level of real expenditures relative to the 1983 level. Another interpretation is that if assignment rates had remained at 1983 levels, real physician expenditures (overall) would have been about 3 percent lower.

The private insurance variable is not significant overall, but was positive in most equations; it was, however, negative and significant in the outpatient regression, contrary to expectations. There was a small increase in the proportion of Medicare beneficiaries with private insurance or Medicaid during this period. The results suggest that this had little effect on real expenditures, probably because such insurance is so widespread to begin with.

## Physician Supply

The next set of variables of interest are measures of physician availability. The results suggest that the higher the availability of specialists the higher the level of 1985 expenditures relative to the 1983 level. The specialists per capita variables are positive in all of the regressions with the minor exception of the other site category. This coefficient is significant in the total services, medical care, consultation, and other types of service equations as well as in the outpatient equation.

The elasticities are quite low, however, being equal to .05 in the total services equation, and .07, .12, and .14 in the medical care, consultation, and other equations, respectively. Because the elasticities are low and physician supply changes relatively slowly, the effect of this variable is very small. As indicated earlier, it is not possible to separate out the effect of induced demand, lower time prices, etc., from the effect of the availability of newer technologies that are made available to Medicare beneficiaries through specialists.

The general practitioners per capita variable was significant overall and negatively related to real physician expenditures. The coefficients suggest that the greater the availability of general practitioners the lower the level of 1985 real services relative to 1983 levels. Again, the overall elasticity was quite low (-.06). Radiology and other type of service were the only ones for which the GP variable was significant.

## Income

The coefficient in the per capita income variable was significant overall and in many individual regressions. During this period there was significant income growth among the elderly population (13.3 percent between 1983 and 1985). The result appears to be higher real spending on Medicare physician services. That is, where incomes were higher, Medicare physician expenditures per enrollee were higher relative to their 1983 levels. The income elasticity was .23 in the total services equation. The income variable was significant in the inpatient and office site of care regressions (elasticities equal to .16 and .31, respectively) and in the medical care, radiology, and consultation regressions (elasticities equal to .34, .55, and .28, respectively). An important omitted variable in our analysis is the introduction of new technologies. To the extent that the availability of new technologies is

correlated with income rather than with specialties per capita, some of the effect of technology is probably incorporated in the income coefficients.

## Malpractice

The next variable of interest is the malpractice premium. The variable was included in the regression because of its possible effect on physician decision making. That is, physicians with greater risk of malpractice claims may be more likely to practice defensively and thus increase the demand for services. The results in the total services equation indicate that malpractice had no significant overall effect on real expenditures. The coefficient is negative and significant in the inpatient, office, and outpatient regressions but positive in the other site of care regression. The variable was negative and significant in the consultation and other type of service equation.[8] The negative effects are somewhat surprising, but suggests that increases in Medicare physician expenditures cannot be attributable to higher levels of malpractice premiums.

## HMO Enrollment

The HMO enrollee variable (the ratio of Medicare enrollees to all Medicare enrollees) is positive and highly significant in most cases. This includes the inpatient, office, and outpatient regressions and in the medical care, consultation, and other type of service regressions. The results mean that the higher the ratio of HMO enrollees per capita, the higher the level of Medicare physician expenditures per enrollee in 1985 relative to its 1983 level. Thus, in markets where HMOs have entered, it appears that the fee-for-service

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8. In the first-stage regressions that were used to estimate instruments for the endogenous variables, malpractice premiums had a strong positive effect on prevailing charges. Thus, where malpractice premiums are higher, prevailing charges are higher, which in turn has a small negative effect on real expenditures.

expenditures are higher in 1985 relative to 1983. This suggests evidence of adverse selection resulting in higher expenditures in the fee-for-service sector.

## Teaching

The teaching variable, which is hospital-based physicians (interns and residents) per capita, was negative and significantly related (at the .10 level) to real expenditures in 1985 once the 1983 level of expenditures are controlled for. The teaching variable was negative and significant in the inpatient, outpatient, and medical care equations. It was hoped that this proxy for teaching status could capture the influence of new technologies. The negative relationship suggests, however, that interns and residents are a substitute for private physicians. Since their costs are absorbed by the hospital and are passed on to Medicare Part A, it reduces Part B billings by other physicians. The effect of technology appears to be incorporated in our income and perhaps our specialty per capita variables.

## Demography and Place of Residence

The demographic variables also provide some results of interest. The 1985 real Medicare physician expenditures per enrollee are higher where the mortality rates are higher, holding constant the 1983 levels of expenditures. That is, real expenditures appear to be changing more in areas with sicker populations. Similarly, real expenditures are higher in areas with high proportions of Medicare beneficiaries in the 65-74 and 75-84 age ranges, once mortality is controlled for. These results show up most strongly for medical care, surgery, and consultations and for inpatient care. Spending on the under-65 population is higher than on the 85-and-over population for surgery and for inpatient care, but not for other sites or for individual type of care.

These somewhat surprising results suggest that the "old" elderly use fewer services than younger elderly.[9] It appears that many services are simply not performed on the oldest Medicare beneficiaries.

Urban/rural status also affects expenditures, although the effects are modest. The large metropolitan areas appeared to have higher levels of expenditures in 1985 relative to 1983 for surgery and radiology, relative to differences in rural areas. Levels of expenditures on care in other sites were also higher in all metropolitan areas, relative to the experience in rural areas.

## VI. MAJOR CONCLUSIONS

These results allow us to draw a number of important conclusions about the recent growth in Medicare physician service volume. From the descriptive data we found an increase in real expenditures of about 10.8 percent between 1983 and 1985 in the services we analyzed (see Table 8). Real expenditures grew much more rapidly for radiology than for other types of services (over 27 percent for the 1983-1985 period). Real expenditures for most services also grew less in PPS than in waiver states, suggesting that PPS could not have been a major factor in explaining the growth in volume. There was also a substantial shift in the site of care in PPS states with a decline in real expenditures in inpatient spending of about 9 percent (versus a 2 percent increase in waiver states). There were very large increases in care provided in out-of-hospital settings, particularly hospital outpatient departments; these increases occurred in both PPS and waiver states but were substantially greater in the former. Finally, there were major differences in real

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9. These results remain even when the mortality variable is excluded from the regressions.

expenditure growth among specialties. Cardiologists had by far the fastest growth rates. Ophthalmologists, radiologists, other specialties, and orthopedic surgeons also had double-digit growth rates over the two-year period. In contrast, expenditures on services of general and family practitioners, general surgeons, and internists grew at much lower rates.

We conclude that a large number of factors have affected the physician service market in recent years. The most important of these are the increased incomes of the elderly and the increase in assignment rates. From our descriptive work as well as indirectly from the econometric analysis, we also conclude that the introduction of new technologies and the end of combined billing for services such as radiology were very important. The introduction of PPS appears to have resulted in increased diagnostic testing out of the hospital, thus a shift to Part B, which offset the reductions in physician expenditures due to lower rates of hospital utilization. The fee freeze and the aging of the population had, at most, a small positive impact. The growth in the supply of physicians had virtually no effect. Finally, the increase in malpractice premiums may in fact have reduced physician spending.

The rising incomes of the elderly appear to have had a relatively important role in explaining increased use of physician services. The elasticity in the income variable was .23. Since the incomes of the elderly increased by 13.3 percent during this period, we estimate that rising incomes could have accounted for 2.9 percent of the volume growth. As noted in our results section, it is quite possible that this variable was correlated with the introduction and diffusion of new technologies, i.e., newer technologies are more rapidly adopted in higher income markets.

The effect of the introduction of new technologies in explaining growth in services is difficult to determine because the variable is extremely hard to

measure; yet evidence from Mitchell (8) suggests that technology plays an extremely important role in contributing to the growth in volume. Our findings in section III on differences in growth in spending across specialties also indicate that physicians--particularly specialists such as cardiologists, ophthalmologists, and radiologists--who have greater access to new procedures have experienced much more rapid growth in services and medicare payments than specialties such as general practitioners, internists and general surgeons. Unfortunately, we cannot provide direct quantitative evidence on the contribution of new technologies to the growth in Medicare volume over this period.

The third factor that played an important role during this period was the physician participation agreement. By signing the physician participation agreement, physicians agreed to accept Medicare rates as payment in full for all patients. Physicians who did not sign the agreement could choose assignment billing on a case-by-case basis. The result of the participation agreement was a dramatic increase in assignment rates from 51 percent in 1983 to 67 percent in 1985. Our analysis has shown that the increased assignment rates of physicians and the accompanying reduction in balance billing led to a very strong demand response. The elasticity on the assignment rate variable was approximately .1. The variable was highly statistically significant in the medical care and radiology equations, with elasticities of .19 and .25, respectively. The implication is that physician volume increased in response to the reduction in out-of-pocket costs; we estimate that physician services volume increased by 2.8 percent due to increased assignment rates alone.

The final factor that contributed in an important way to growth in physician services during this period is the termination of combined billing by hospitals for radiology, pathology, and other services. This change in

Medicare regulations required that physicians bill for the professional component of services, say radiology or laboratory service, as Medicare Part B. As expected, we observed a substantial increase in radiology expenditures (the only affected service analyzed in our study) in both PPS and waiver states. The growth in radiology services was dramatic at levels of greater than 27 percent between 1983 and 1985 in both PPS and waiver states. Because radiology services also grew rapidly in the waiver states, the growth cannot be interpreted as a PPS effect; the end of combined billing which occurred nationally is the more likely explanation. To the extent this affected other services (such as diagnostic laboratory which was not directly included in our research) in addition to radiology, it could have accounted for a significant share of Part B physician service volume growth during this period.

Some factors that we analyzed did not appear to contribute to Part B physician volume growth. One is the sharp decline during this period in hospital admissions and lengths of stay. Both led to a decline in the overall volume of physician services. Declining admission rates and lengths of stay clearly led to a decline in physician services provided in inpatient settings. However, while there is evidence of increases in services provided in physicians' offices and outpatient departments in response to declining lengths of stay, these were not sufficient to offset the decline in services provided in inpatient settings. Declining admission rates were associated with reductions in medical care services and surgery. Declining lengths of stay were associated with fewer medical care services, less radiology and other services and fewer consultations.

We also looked at the effect of the physician fee freeze. We conclude that for the four types of service we examined—medical care, surgery, consultations, and radiology—there is no overall significant effect of the fee

freeze on physician service volume. We did find that the volume of surgery and radiology was significantly higher than it otherwise would have been. On the other hand, there was evidence of a reduction in consultations. Medical care services did not appear to be affected. Thus, the net overall effect of the fee freeze was not statistically significant. Interpretation of the effect of the fee freeze is not straightforward. Because fees were less than they otherwise might have been, patients faced lower co-insurance payments and, thus, may have increased their demand for services. But since most patients have either Medigap insurance or Medicaid (about 70 percent), and are therefore not liable for co-insurance payments, it is perhaps more plausible to interpret the responses to the fee freeze as a physician supply response. However, because the reduction in fees (below where they would have been without the freeze) was substantially greater than the volume increase, the net effect was a reduction in Medicare expenditures.

These results may have implications for the aggregate effects on volume of the adoption of a relative value scale. Suppose that radiology and surgery, i.e., procedures, fees were to be reduced and medical care and consultations, i.e., cognitive services, increased. The econometric results suggested that reductions in radiology and surgical fees could be followed by small increases in volume. Similarly an increase in fees for medical care and consultation could be followed by insignificant and positive responses respectively. The net effect would be an increase in volume due to the shift in relative values. However, one must be cautious in interpreting these coefficients beyond the range of prices on which the estimates are based.

The growth in the supply of physicians and the shift toward specialization seems to have had little effect on growth. We find that the growth in the supply of physician specialists led to a small increase in spending, while the

growth in general and family practitioners has led to a small decline in spending. The elasticities on these variables in our total real expenditure equations were .05 and -.06. Since the supply of specialists has grown by only 4.3 percent between 1983 and 1985, we estimate that its impact on Medicare real expenditures for physician services is only 0.25 percent. In contrast, the effect of the increase in general and family practitioners was a 0.15 percent reduction in spending. Taken together, the full effect of the growth in the supply of physicians was only a 0.1 percent increase in real expenditures.

Similarly, we conclude that the aging of the elderly population could have accounted for only a small share of the growth in Medicare physician spending. While beneficiaries between ages 75 and 84 appear to use more than younger beneficiaries, all age groups use more care than the age 85 and over population. While the age 85 and over group have much higher mortality rates than the younger elderly, and while mortality is positively and significantly related to real expenditures, the lower spending of the 85 and over group remained after excluding the mortality rate variable from the regression. Thus, we conclude that (1) because the "oldest" old use less care and (2) because the aging of the elderly occurs only very slowly, this factor contributed very little to real growth in Medicare spending.

We also tested for the effects of malpractice premiums on the volume of physician services. Higher malpractice premiums reflect increased risk of claims which should lead to more "defensive medicine." But whether "defensive medicine" translates into more or less care is not immediately obvious. On the one hand, defensive medicine could lead to more services as caution leads physicians to perform more diagnostic tests. On the other hand, the increased risk of malpractice claims may result in physicians being less willing to perform certain types of procedures. Although the impact of the malpractice

variable in our model is quite small, our results, nevertheless, suggest that physicians are less likely to admit patients to hospitals and that the volume of physician services is somewhat lower when premiums are higher.  However, while the malpractice elasticity is small, the growth in malpractice premiums was rather large.  The results, therefore, suggest that, if anything, higher malpractice rates result in less not more physician services.

There was a rapid growth in HMO enrollment of Medicare beneficiaries during this period.  While we could not calculate the net effect of this increase in HMO enrollment on Part B spending, it does appear to have resulted in an increase in fee-for-service billings—an effect that appears to be due to adverse selection as the fee-for-service sector was left with a less healthy population.

Finally, our conclusions with respect to the effect of PPS are worth reviewing in some detail.  As noted above, when one looks at the raw data, the growth in Medicare physician expenditures was less in PPS than in waiver states.  However, from the econometric analysis, we conclude that the implementation of PPS had, on balance, a small positive effect on physician service volume during this period.  We estimated both the direct and indirect effects of PPS.  The indirect effects occurred because PPS provided hospitals with strong incentives to reduce lengths of stay; it may also have provided incentives for hospitals to reduce admissions although the evidence on this is much less clear.  Our econometric results suggest that PPS did not affect admission rates.  However, other evidence indicates that admission rates may have fallen because of PPS.  As noted above, declining admission rates and lengths of stay contributed to decreases in physician service volume.  Thus, to the extent that PPS reduced admissions and lengths of stay, physician services fell in response.  We estimate that PPS reduced volume by anywhere from 1.3

percent to 2.5 percent through its effects on lengths of stay and from 0.0 percent to 0.6 percent through its effects on admission rates.

A more direct effect of PPS was its provision of a strong incentive to move certain types of services out of the hospital entirely. As indicated above, the combined billing regulations required that physicians bill for the professional component of radiology and other services as physician services under Part B. PPS with its fixed payments per case also provided incentives for hospitals to move the technical component of services such as radiology out of the hospital entirely. Our results indicated an increase in radiology billings (and perhaps laboratory services) in PPS states. Thus, PPS had contradictory effects on real outlays for physician services. Through its effects on admissions and lengths of stay, volume declined. Through its independent effect on moving physician services, such as radiology and "other" services, out of the hospital, it resulted in an increase in physician service volume. The latter effect seems somewhat stronger than the former. We again caution that the direct PPS effect was not statistically significant. Thus, we cautiously conclude that there was probably a small increase in physician services due to PPS.

APPENDIX A

## APPENDIX A

### DEVELOPING MEDICARE PREVAILING CHARGE INDICES

This study uses data from the 1983 Bill Summary Record and the 1985 BMAD files. The Bill Summary Record provides data on physician expenditures, disaggregated by type and place of service, specialty, and assignment status. In order to be able to make comparisons over time, the more detailed BMAD data has been aggregated to parallel the expenditure data on the Bill Summary Record. For analysis purposes, there is a need to construct price indices with which to deflate these expenditures both across areas and over time. Since no such price deflators are readily available, we have developed indices based on Medicare prevailing charge data. Several steps were taken. The first is selecting of the procedures to be used in the index; the second is developing weights for each charge; the third is testing the validity of the resulting index; the fourth is aggregating the locality-specific indices to the SMSA level;

We developed several indices: one each for medical care, surgery, and radiology. (The medical care indices are used for consultations.) The indices are based on locality-level prevailing charges in 1985 as reported to HCFA by each carrier. These are the data used in Medicare Directory of Prevailing Charges. Although a 1985 edition was not published, a computer-readable version is available. Unfortunately, there are many missing values because not all localities report prevailing charges for each procedure. Therefore, each index is based on the procedures that were most commonly reported for the most localities. We arrayed procedures in order of frequency of reporting and moved down the list until we had a representative number of procedures for which prevailing charges were available for a large number of localities. In the

case of medical care, data were available for 10 procedures for 134 localities; surgery, 8 procedures for 155 localities; and radiology, 6 procedures for 135 localities. We attempted to be representative in terms of the kinds of procedures used in the index, but the most important criterion in this selection process was the number of localities for which data were available. Table A.1 lists the procedures used in the indices.

We then calculated each procedure's weight: its expenditure as a percentage of total expenditures for all the procedures in its index. To handle missing charge data, we developed a relative value scale for each of the three types of service based on the procedures' national average prevailing charges. For each type of service, national averages were based on the localities that reported data for all procedures included in the relevant index. These averages were weighted by the number of times each service was performed in the locality (i.e., frequency). Each relative value was computed as the ratio of the procedure's national average charge to the overall national average charge for all procedures in the same type of service category.

These relative values were used to impute the prevailing charge for each procedure wherever it was missing. The relative value for the procedure whose charge was missing was multiplied by the available charge for the procedure most commonly reported across other localities and then divided by the relative value of the available charge.

A simple example can illustrate this process. Suppose data on prevailings for medical care services from a subset of localities and procedures were arrayed as follows:

|           |   | Procedure |          |          |
|-----------|---|-----------|----------|----------|
|           |   | 1         | 2        | 3        |
| Locality  | A | $P_{1a}$  | --       | $P_{3a}$ |
|           | B | $P_{1b}$  | $P_{2b}$ | --       |
|           | C | --        | $P_{2c}$ | --       |
| Relative Value |  | $RV_1$ | $RV_2$   | $RV_3$   |

In this scheme, $P_{ij}$ refers to the prevailing charge for procedure i in locality j and $RV_i$ to the relative value for procedure i. Assume that i is ordered so that 1 implies the most commonly reported charge and 3 implies the least commonly reported. The missing charged data is imputed as:

$$P_{2a} = P_{1a} * \frac{RV_2}{RV_1}$$

$$P_{3b} = P_{1b} * \frac{RV_3}{RV_1}$$

$$P_{1c} = P_{2c} * \frac{RV_1}{RV_2}$$

$$P_{3c} = P_{2c} * \frac{RV_3}{RV_2}$$

An index for each locality was then developed by multiplying each locality's prevailing charge, whether actual or imputed, by the expenditure weight, summing across procedures and dividing by the national average of these sums.

We were concerned that the indices might not be reflective of all procedures. If, however, most prevailing charges are highly correlated with the index for their service type, then the fact that the deflators are based on

a subset of prevailing charges should not be a serious concern. To explore these correlations, we regressed each procedure's prevailing charge against the relevant index, using data for each locality for which we had data. In general, the $R^2$'s were greater than .9 and the index as an explanatory variable had an extremely high t-ratio. (These regression results are available from the authors.)

The indices as summarized above were first constructed for each of Medicare's geographic localities. Because we need the indices at the SMSA level, we developed weights based on Medicare enrollees in each locality. The weights were the ratio of Medicare enrollees in a locality to Medicare enrollees in the SMSA. By multiplying these weights by the locality indices we were able to develop an SMSA index for each procedure type. These indices were then used to deflate expenditures.

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